Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

2500

REFERENCE GUIDE

MOVING WAY TRANSIT

LIGHT GUIDEWAY TRANSIT

PERSONAL RAPID TRANSIT

LIGHT RAIL TRANSIT

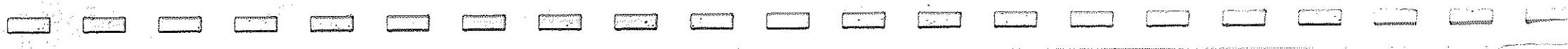
HEAVY RAIL TRANSIT

BUS TRANSIT

PARA-TRANSIT

ROADWAY TRANSIT EQUIPMENT

Vol. II No. 3, 1975



PREFACE

This issue is devoted to Light Guideway Transit systems which have been defined in the Reference Guide as:

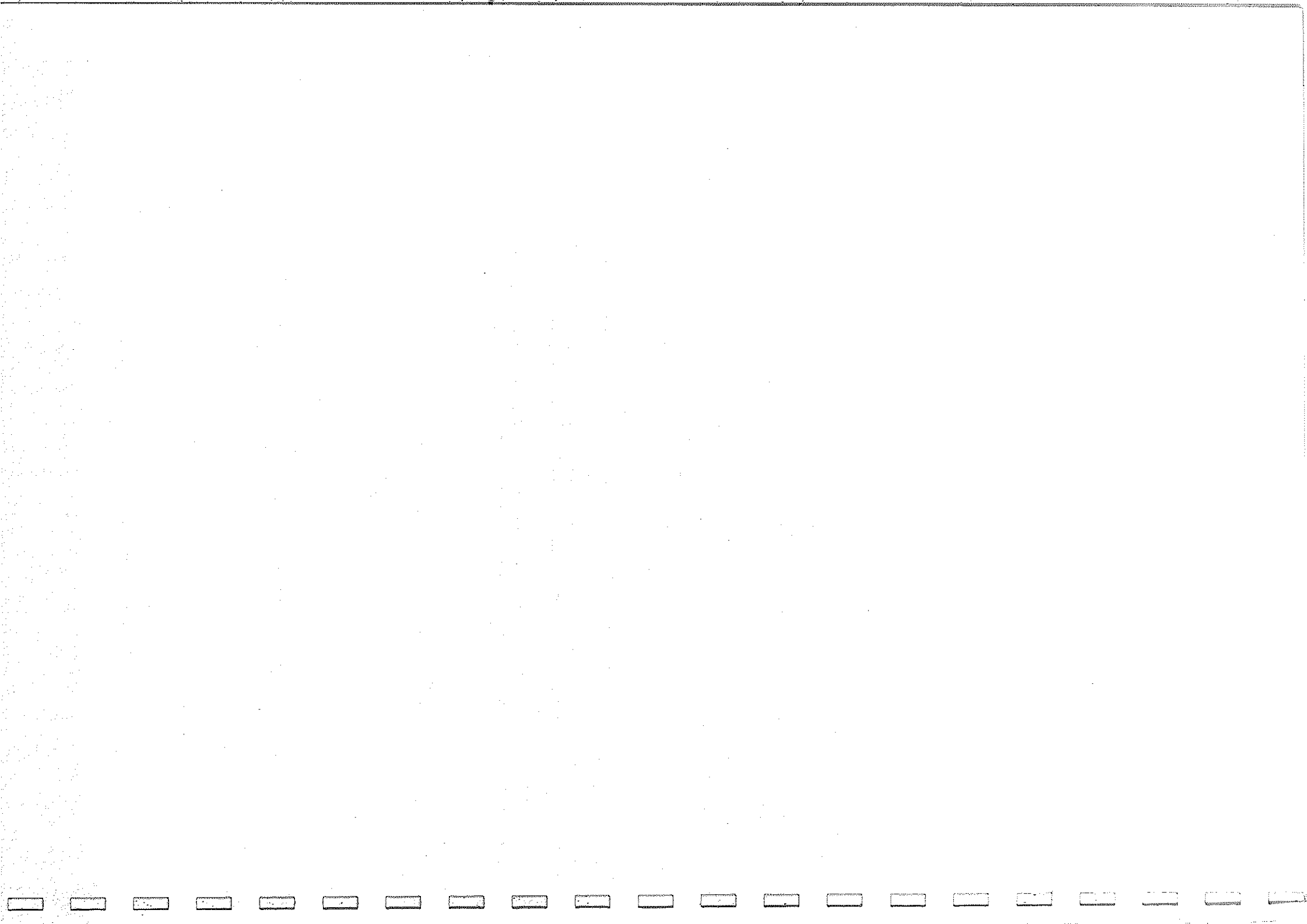
> "Vehicles are operated singly and in some cases in small trains over an exclusive guideway under automatic control. Stations can be either on-line or off-line. The vehicles are usually the size of a small bus with approximately the same passenger capacity permitting standees. In the off peak hours some systems may offer personal, demand activated service."

A primary objective of the LEA TRANSIT COMPENDIUM is to remain impartial and unbiased in its choices of systems reported as well as the specific information and data. Therefore, the systems reported in this issue are not specifically endorsed or preferred by N. D. Lea Transportation Research Corporation over any systems which are not included. Further, no attempt has been made to rank or compare the systems reported. Any comparison would have to be made with respect to the conditions under which the systems would operate.

Regarding systems in this issue, of the thiry-three systems in the 1974 issue twenty-nine systems have been retained, two have been dropped, two were moved to the Moving Way Transit issue this year and six new systems have been added. The new systems are: Disney System (U.S.A.), Komptbahn (West Germany), Minitram (GEC) (England), NTS (Japan), Okinawa KRT (Japan), and Tridim (France). The data format has been changed somewhat from the 1974 LGT issue to include more data and information on vehicle performance, safety features, and guideway design.

The reader if cautioned that the data and characteristics of the systems reported are subject to change. Therefore, data and information from the included data sheets should not be the sole source of information in assessing or comparing the relative merits of individual systems. Also they should not be used as the basis of the design of site specific installations – such information and data, for that purpose, should be obtained directly from the developer, manufacturer, or supplier.

Comments and suggestions are solicited from readers and developers regarding improvements in data sheet format, data considered unnecessary or that should be added, and more definitive data presentation techniques.



Lea transit compendium

CURRENT INTERNATIONAL DEVELOPMENTS IN TRANSIT TECHNOLOGY

CONTENTS

COMPREHENSIVE TRANSIT SYSTEM

CLASSIFICATION: Light Guideway Transit

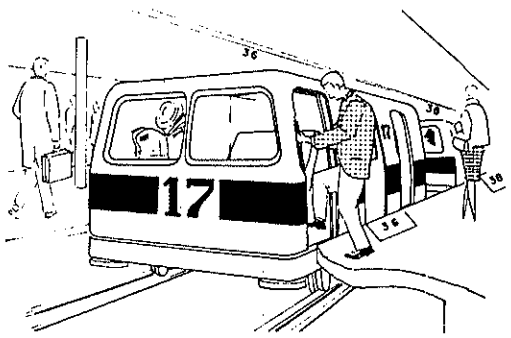
OTHER NAMES: None

DEVELOPER: Mr. H. J. Edens
DeLeuw, Cather & Co. of Canada Ltd.
133 Wynford Drive
Don Mills, Ontário
Canada M3C 1K1
Tel: (416) 429-3411

PATENTS: Canada Patent Nos. 977,708 and 824,761
U.S. Patent Nos. 3,430,580 and 3,530,802

DATA REFERENCE CODE: [b 11]

STATUS OF DEVELOPMENT:
Concept — 100% complete;
Prel. Dsgn — 50%



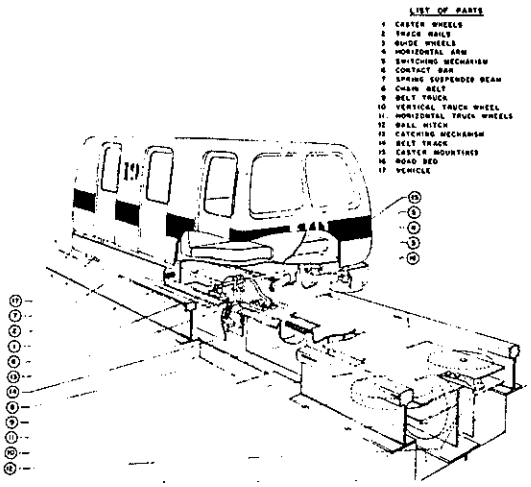
VEHICLE AT STATION PLATFORM

SYSTEM DESCRIPTION:

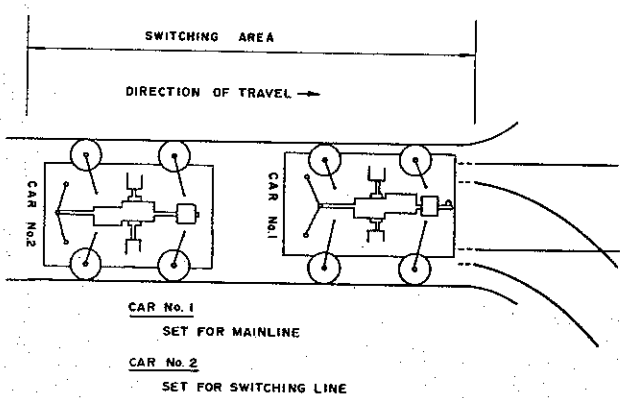
The system is a Light Guideway Transit system in which passengers are carried in 6-passenger vehicles for non-stop trips between origin and destination stations. At the origin station, individual passengers register their desired destinations at a console and are assigned a vehicle number. Up to 6 passengers with like destinations may be assigned the same vehicle. The vehicle has 6 side doors so that entry can be gained directly to each seat. Mainline speeds between 20 and 70 mph (32-113 km/hr) are proposed.

Each vehicle is supported on four specially designed steel flanged wheels which ride on steel rails. Four lateral rubber tired wheels are provided as guidewheels and are a part of an on-vehicle switching mechanism.

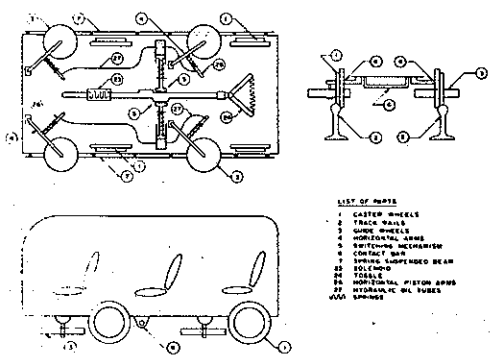
The vehicle is propelled by attaching itself to a guideway mounted conveyor along the way. Headway control is therefore a mechanical function. The conveyor consists of a series of coupled beamlike, T-sections, approximately 50 ft (15 m) long, resting on small belt-trucks and riding on vertical wheels. The horizontal wheels can ride against springs which allow for adjustments in curved sections. The belt links are coupled via a ball type hitch.



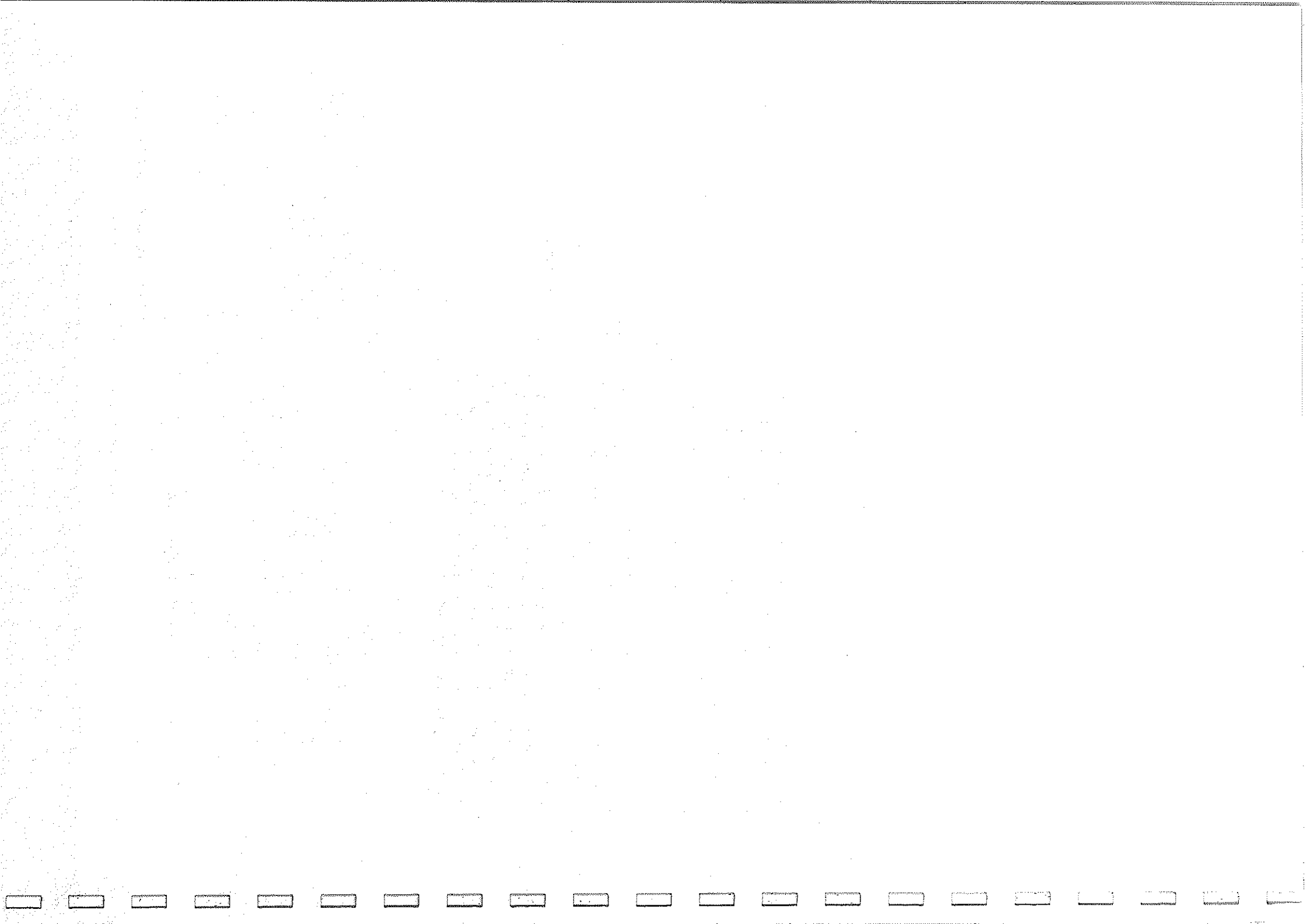
MAINLINE PROPULSION



SWITCHING MECHANISM



FUNCTIONAL DESIGN OF VEHICLE



EITO (Endless In-City Transport Operation)

CLASSIFICATION: Light Guideway Transit and Moving Way Transit

OTHER NAMES: None

DEVELOPER: Mr. D. K. Paul
P. O. Box 826
Mulino, Oregon 97042, U.S.A.
Tel: (503) 632-4263

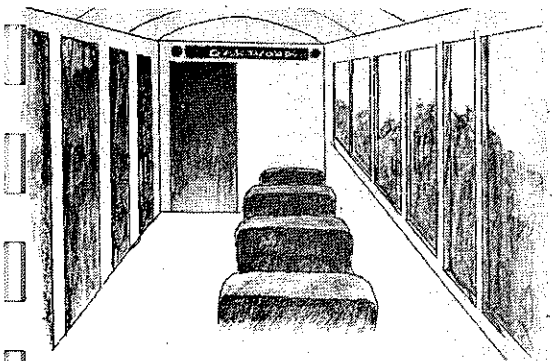
PATENTS: U.S. Patent No. 3,482,529

DATA REFERENCE CODE: [b 11]

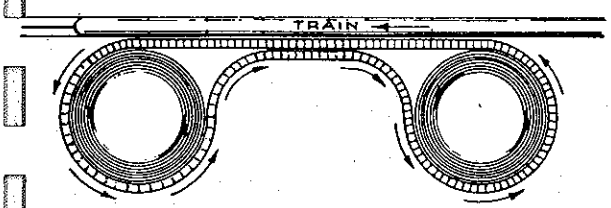
STATUS OF DEVELOPMENT: Concept — 100% complete

SYSTEM DESCRIPTION:

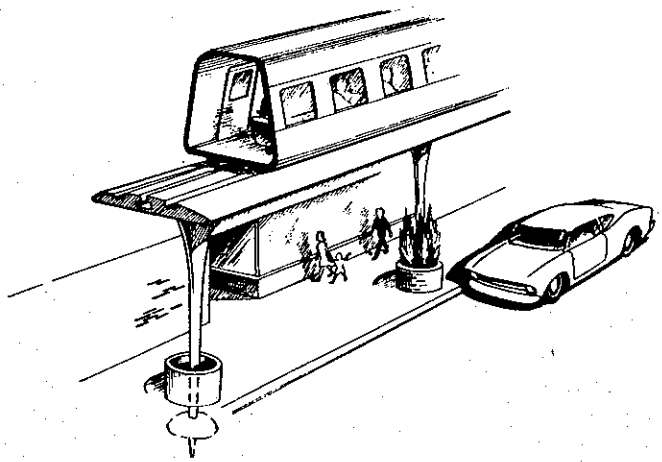
The system is a non-stop continuously moving train which passengers board via a moving way system. Passengers step aboard a rotating complex of 7 concentric rings, the first of which maintains a constant tangential speed of 2.143 mph (3.45 km/hr). The velocity of each adjacent ring is 2.143 mph greater than the previous ring so that the 7th ring is rotating at 15 mph (24 km/hr). The 7th ring terminates in a wall studded with elevator-like doors. The passenger presses a button for the door to open. At the proper time the door opens to reveal a compartment similar to that of an elevator. Upon leaving the rotunda, the compartments travel in a straight line adjacent to the non-stop train. The doors on the opposite side of the booth open at the proper time synchronous to those of the train allowing transfer to the train to be accomplished. Passengers disembark in the reverse manner. A simpler installation has 3 concentric rings, at incremental speeds of 2.5 mph (4.02 km/h), which give access, via the same compartments, to a high constant speed moving walkway of 7.5 mph (12 km/h).



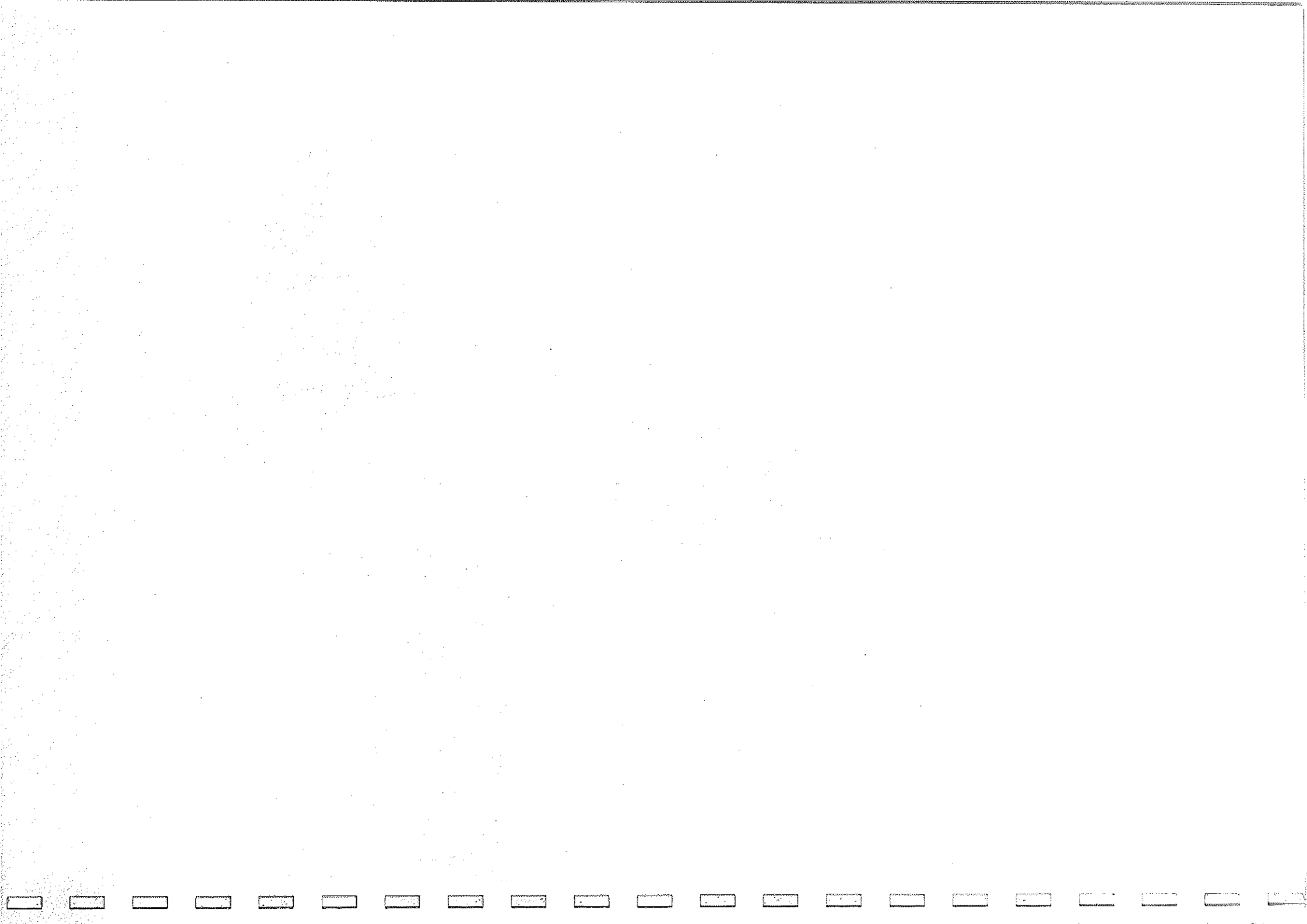
TYPICAL TRAIN VEHICLE — INTERIOR



BOARDING CONCEPT



TYPICAL INSTALLATION



METROMATIC

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Mr. P. M. Bourassa
7415 Malo Street
Brossard, P.Q.
Canada J4Y 1C1
Tel: (614) 886-2701

PATENTS: Patent application in U.S.A.

DATA REFERENCE CODE: [b 11]

STATUS OF DEVELOPMENT: Concept — 100% complete;
Preliminary Design — 35% complete

SYSTEM DESCRIPTION: [a]

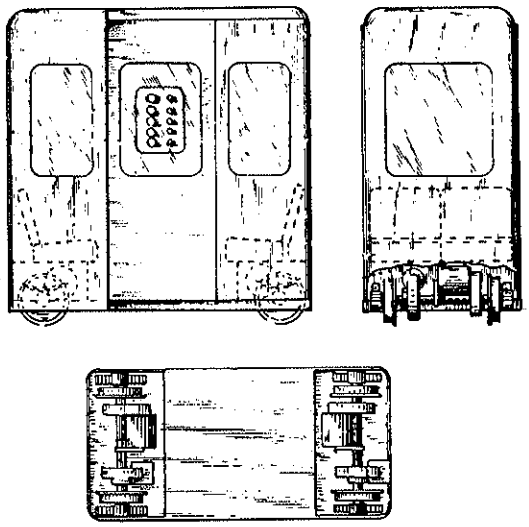
Metromatic is a Light Guideway Transit System for transporting passengers in small vehicles under totally automatic control over exclusive guideways. Service is on-demand collection/distribution along a line or around loops between off-line stations.

Vehicles operate at headways between 5 and 10 seconds with correspondent one-way line capacities between 1,500 and 11,500 passenger/hr. Individual vehicle capacity may range from 4 to 16 passengers seated and standing.

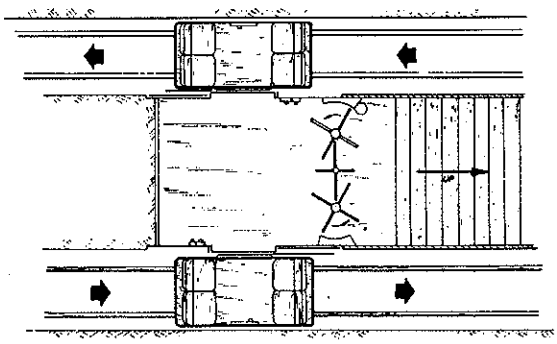
The vehicle is supported on flanged steel wheels running on conventional steel rails. The cruise velocity is nominally 30 mph (48 km/hr). Average velocity for a station spacing of 0.25 mi (0.4 km) is approximately 20 mph (32 km/hr).

Vehicles are 5.5-16 ft (1.68-4.88 m) long, 3.5 ft (1.07 m) wide, and (2.29 m) high and weigh 1 to 3 tons empty, 1.25 to 4 tons loaded. Service accel/decel is 4.8 ft/s^2 (1.46 m/s^2). Propulsion is by ac induction or synchronous rotary electric motor. Switching is electromagnetic, on-guideway with a switch time between 1 and 2 seconds.

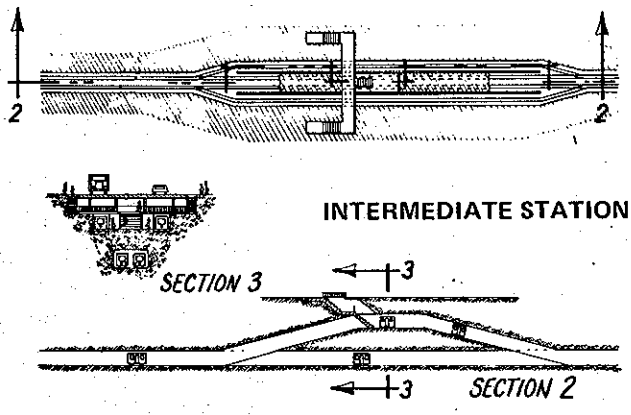
Total capital cost including guideway, stations, rolling stock, and other equipment, is estimated to be $1.25 million per one-way mile ($0.77 million/km). Operating and maintenance cost is estimated to be $104,000 per mile per year. Including 40 year depreciation on system and 10 years on equipment, at 8% interest the total operating cost is estimated to be $224,000 per mile per year.



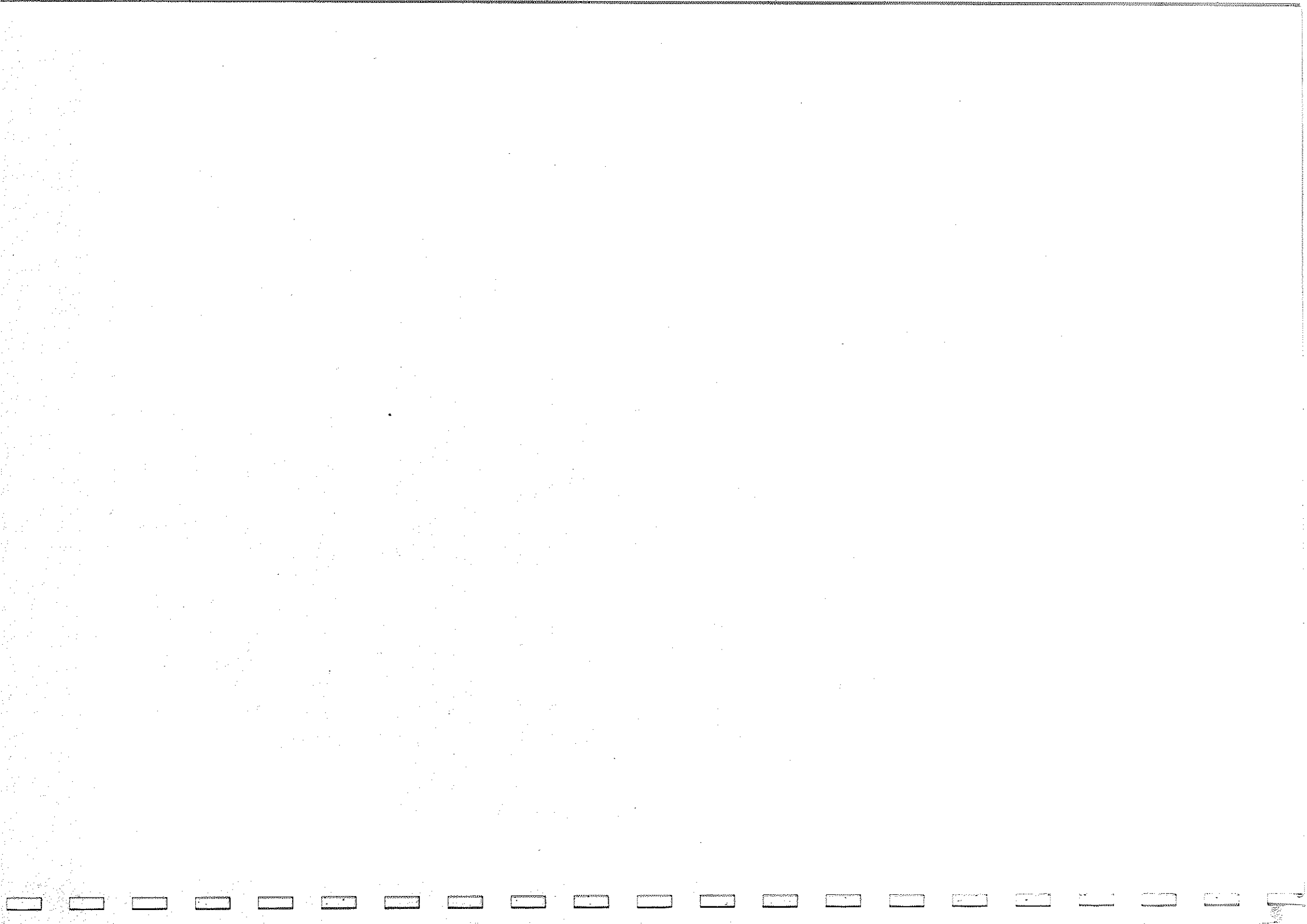
VEHICLE



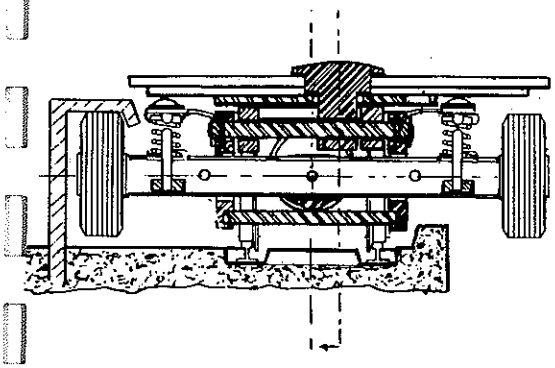
STATION BOARDING AREA



INTERMEDIATE STATION



MONO TRI-RAIL SYSTEM



SUSPENSION SYSTEM – CROSS SECTION

CLASSIFICATION: Light Guideway Transit and Heavy Rail Transit

OTHER NAMES: None

DEVELOPER: Mono Tri-Rails, Ltd.
P. O. Box 601
Pasadena, California 91101

PATENTS: U.S. Patent 3,152,559 and other patents pending

DATA REFERENCE CODE: [b 11]

STATUS OF DEVELOPMENT:
Concept - 100% complete;
Prel. Dsgn - 50% complete

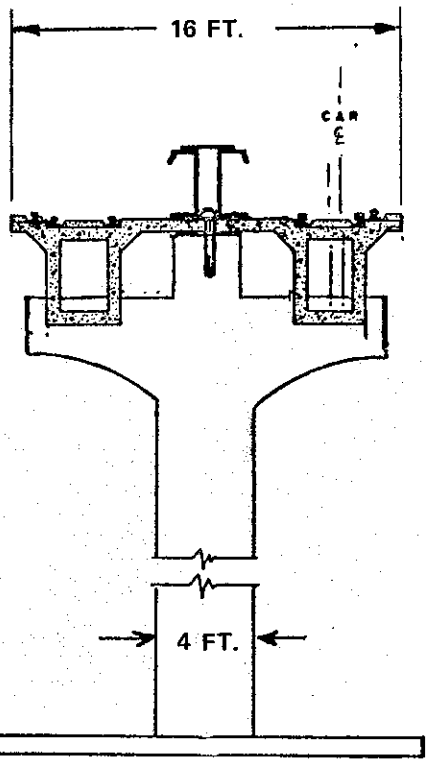
SYSTEM DESCRIPTION:

The Mono Tri-Rail System is essentially a suspension system technology whereby the vehicle is supported by flanged steel wheels on steel duo-rails. Additional support is provided by rubber tires on outriggers to preclude the overturning movement. The vehicle is cantilever supported; therefore, reducing the width of the guideway.

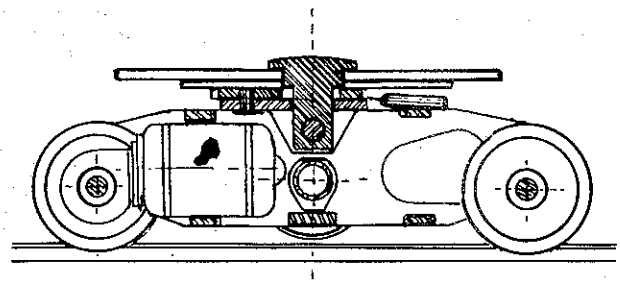
The guideway structure is proposed to be elevated. The suspension technology is proposed to be applied to a range of systems between light guideway and heavy rail.

PUBLISHER'S NOTE

The system has been classified as LGT because it is expected that any initial application would occur first for the LGT application.



TYPICAL ELEVATED GUIDEWAY
CROSS SECTION



SUSPENSION SYSTEM – SIDE VIEW

RELAY RACE

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Dr. T. Z. Harmathy
1834 Playfair Drive
Ottawa, Ontario
Canada K1H 5S1
Tel: (613) 733-6873

PATENTS: U.S. Patent No. 3,624,831
Canada Patent No. 908,652

DATA REFERENCE CODE: [b 11]

STATUS OF DEVELOPMENT: Conceptual

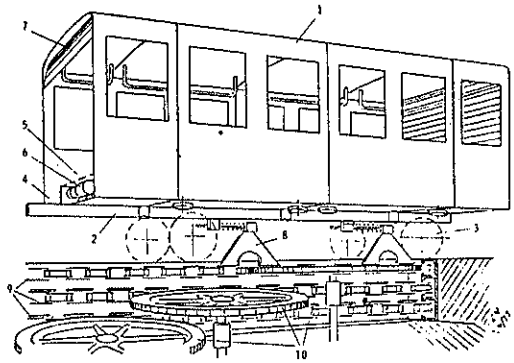
SYSTEM DESCRIPTION:

The Relay Race system is a concept whereby the vehicles rendezvous and dock with one another, with the through-passengers automatically transferring between the docked vehicles therefore eliminating the need for intermediate station stops.

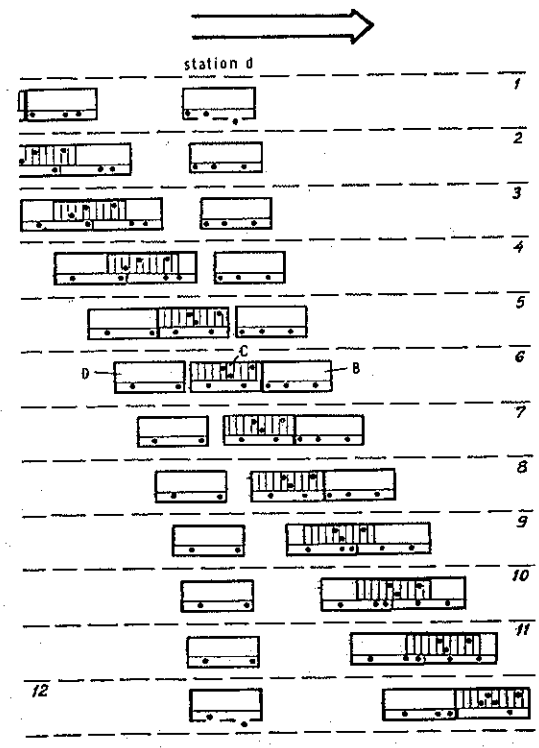
All vehicles are of identical design with side doors on one side only and fore and aft "roll-up" or "fold-up" doors. The interior of the vehicles are divided lengthwise into two areas: a "strip area" adjoining the side doors, and a wider elevated "operational area." The "operational area" is accessible from the "strip area" only when covered by a mobile "people-platform," which is the instrument of at-speed passenger transfer.

Twelve phases of the operation are shown in the figure to the left. Passengers (shown as dots) are boarding vehicle B at station d (phase 1). Up-stream vehicles, C and D, are docked. Through-passengers (to bypass station d) stand on the "people platform" (lined area) where they are automatically transferred from vehicle D to vehicle C. Passengers, wishing to disembark from vehicle D at station d, stand on the "strip area" next to the side doors. In the meantime vehicle B accelerates to the line speed (phases 2-5). By phase 5, the passenger transfer from vehicle D to vehicle C is completed and the two vehicles separate. In phase 6 vehicle C couples with vehicle B. Vehicle D decelerates in the following phases to stop at station d where its remaining passengers can disembark (phase 12). At the same time (phases 8 through 12) transfer of passengers is shown between vehicles C and B.

Under certain conditions the Relay Race system can be operated via three chains from three sets of stationary motors, brakes and control equipment. For further information see "A Novel System for Improving Urban Transportation", Highway Research Record No. 367, 1971, pp. 58-69.

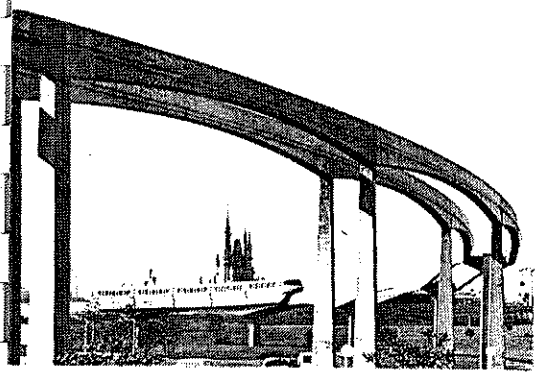


PRINCIPLE OF OPERATION



TYPICAL VEHICLE
IN A CHAIN-DRIVEN VERSION

WALT DISNEY WORLD MONORAIL TRAIN/WEDWAY PEOPLEMOVER SYSTEM



DISNEYWORLD MONORAIL TRAIN

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: Mark IV/Disneyland's PeopleMover System

DEVELOPER: Community Transportation Services
1401 Flower Street
Glendale, California 91201
Tel: (213) 245-8951

LICENSEES: Information unavailable

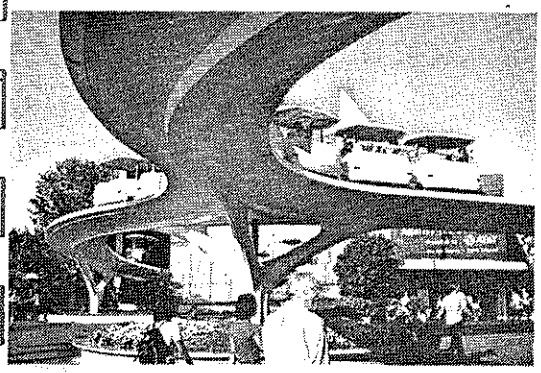
PATENTS: Data unavailable

DATA REFERENCE CODE: [a 51]

MONORAIL TRAIN IN STATION

SYSTEM DESCRIPTION: Walt Disney World Monorail Train

The system is a monorail train incorporating an air-suspension system to achieve a smooth ride. Each compartment has climate controlled air-conditioning. Safety features include pilot-controlled doors and an anti-collision automatic braking system. Each train's operator can monitor 33 operational functions. The at-and/or above-grade guideway consists of pre-cast beams with curved haunches, pre-cast columns, and cast-in-place substructure. The supporting columns have a maximum height of 60 ft (18.3 m). The prestressed girders vary from 90 ft (27.4 m) to 110 ft (33.5 m) in length; midspan depths are 4 ft (1.22 m) and at the ends with parabolic haunches they are 6.67 ft (2.03 m) in depth. They are cast with hollow cores to keep weights under 100,000 lbs (45359.2 kg).



WEDWAY PEOPLE MOVER

SYSTEM DESCRIPTION: WEDway PeopleMover System

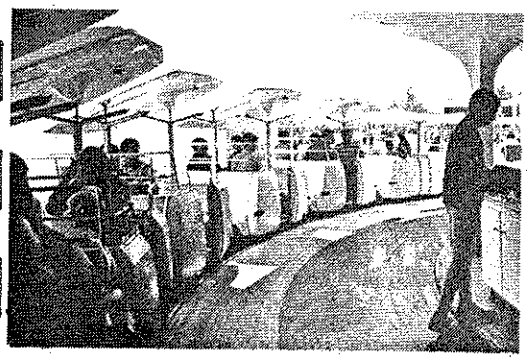
A key factor in the overall efficiency of the Disneyland PeopleMover is found in the passenger loading and unloading technique. Calm and orderly loading is accomplished after the passengers step onto a moving circular platform which is synchronized to the speed of the vehicle being loaded. This method affords the safety of a "standing still" loading/unloading operation without having to stop any of the vehicles.

Each of Disneyland's PeopleMover units consists of four adjoined vehicles forming a 20-passenger "train". Each train is propelled by a series of electric motor-driven rubber wheels imbedded in the course's guideway. Control systems for the imbedded wheels permit variance of speed along the route. In this application, the WEDway cars ride on a steel guideway supported by an elevated concrete roadbed.

In 1967 Disneyland inaugurated its WEDway PeopleMover System which, through September 1974, carried nearly 30 million people over 23 million passenger miles on the 3/4 mile course in Tomorrowland.

The WEDway PeopleMover System to be introduced in 1975 will feature an all new, fully tested electric linear motor system. It operates by creating a magnetic field which "pushes" the vehicle along its elevated guideway.

As an outgrowth of this unique system a "reactance rail" system will also be offered. Whereas the above system has linear motors mounted in the guideway, the "reactance rail" design incorporates its motors within the vehciles. Energized stators in the motor react with the rail to create the same type of magnetic "propulsion" found in the new WEDway PeopleMover.



ROTATING STATION OF WEDWAY PEOPLE MOVER

ACT (Automatically Controlled Transportation)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Ford Motor Company
Transportation Systems Operation
Garrison Place West
P.O. Box 2545
Dearborn, Michigan 48123, U.S.A.
Tel: (313) 337-8566

LICENSEES: None

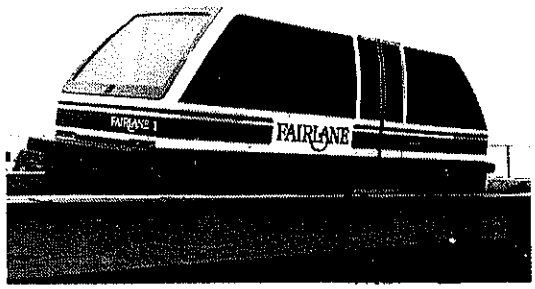
PATENTS: U.S. patents issued: 3,712,238; 3,712,239; 3,768,829; 3,730,583; 3,773,446; 378,233

U.S. patents applied for: 71-147; 71-152; 71-153; 71-486; 73-303; 73-377; 73-450; 74-199

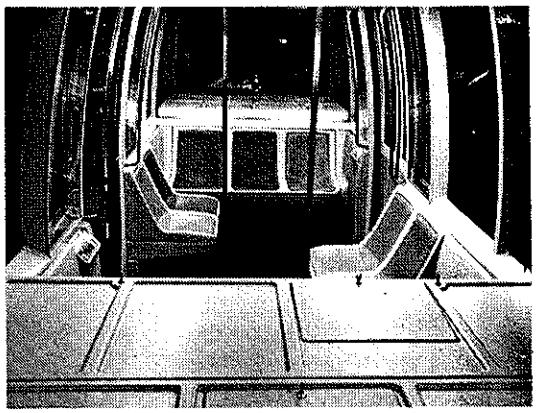
DATA REFERENCE CODE: [a 21/a 51: except as noted]

SYSTEM DESCRIPTION:

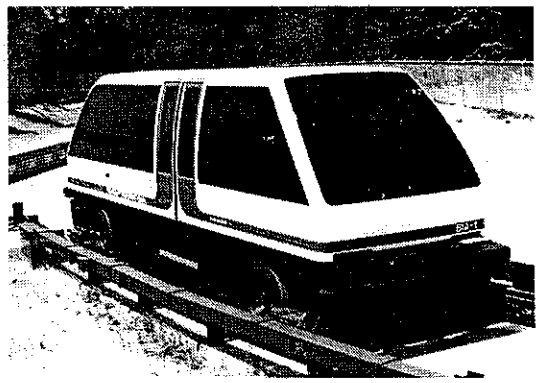
The Ford ACT system is a Light Guideway Transit system with service point-to-point or in collection/distribution, utilizing driverless rubber-tired electrically propelled vehicles which operate under computer control on a passive exclusive guideway to transport both people and cargo. The system operates as a simple shuttle, simple network system and has the potential to operate as a complex, demand-responsive system through addition of wayside modular units. In the demand mode, in the event there is a choice of destinations, passengers select their destinations on-demand, board the vehicle, and travel directly to their destination, or make a minimum number of stops enroute. The system could operate on fixed schedules during peak loads or on-demand during off-peak periods. Stations can be on-line or off-line.



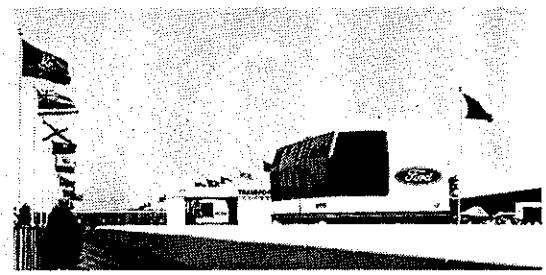
FAIRLANE SHOPPING CENTER VEHICLE



INTERIOR OF FAIRLANE VEHICLE



BRADLEY INTERNATIONAL AIRPORT VEHICLE



TRANSPO '72 DEMONSTRATION

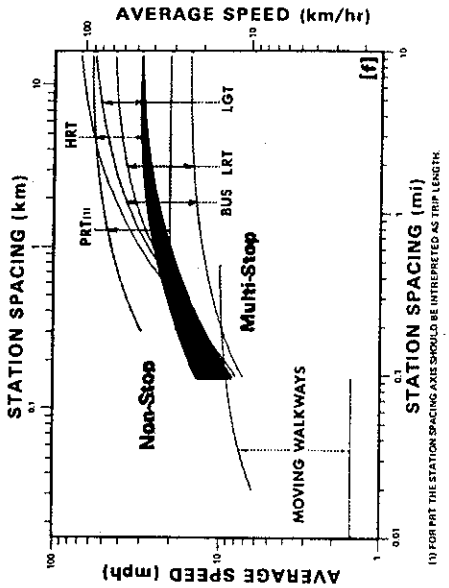
OPERATIONAL CHARACTERISTICS

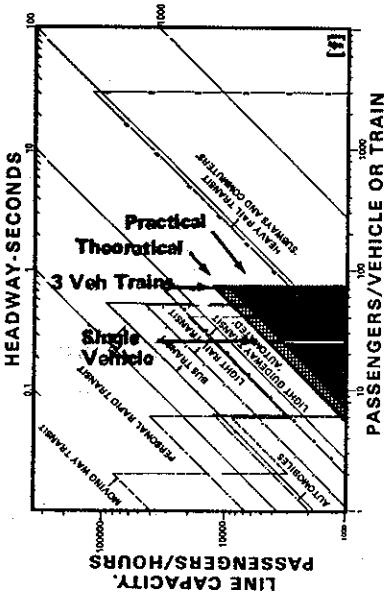
SYSTEM PERFORMANCE:

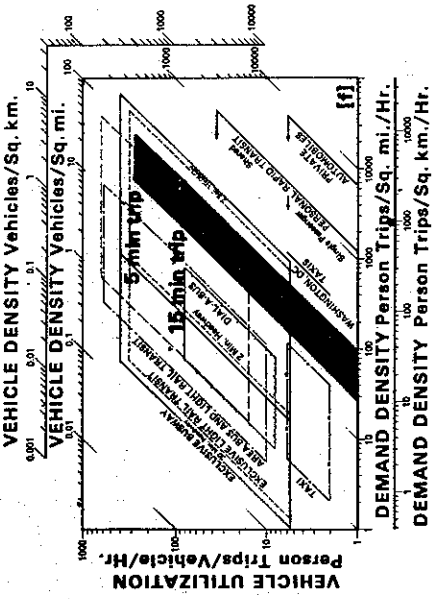
Max Theoretical One-Way Capacity	16,200 psgr/hr
Max Practical One-Way Capacity	12,960 psgr/hr [f]
Min Theoretical Headway	20 sec
Min Practical Headway	25 sec [f]
Availability	Scheduled or on-demand, 24 hrs/day
Type Service	Limited area, point-to-point, and/or collection/distribution
Type Network	Simple shuttle, simple network, potential area grid
Type of Vehicle Routing	Fixed or variable
Traveling Unit	Single vehicle or 2-3 vehicle trains

PUBLISHER'S NOTE:

The decision to publish this system as LGT is based on its present design and hardward status.







VEHICLE PERFORMANCE:

Cruise Velocity . . . . . 30 mph (48 km/h)
Max Velocity . . . . . 30 mph (48 km/h)
Max Grade . . . . . Currently 6%, potential of 10%
Service Acceleration . . . . . 3.2 ft/s^2 (0.98 m/s^2)
Service Deceleration . . . . . 3.2 ft/s^2 (0.98 m/s^2)
Max Jerk . . . . . 3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel . . . . . Approx 9 ft/s^2 (2.7 m/s^2)
Stopping Precision in Station . . . . . ±6 in (±152 mm)
Degradation if Guideway is Wet . . . . . None
Degradation for Ice & Snow . . . . . Speed reduced by approx 1/2 to maintain same stopping distance
Vehicle Design Capacity . . . . . 10 seated 14 standing
Vehicle Crush Capacity . . . . . 10 seated 20 standing
Energy Consumption, Accelerating and Decelerating Only
Empty Vehicle . . . . . 0.0164 kwh/mph (0.01025 kwh/km/h)
At Design Capacity . . . . . 0.0426 kwh/mph (0.02050 kwh/km/h)
Energy Consumption, Cruise Only
Empty Vehicle . . . . . 1.0 kwh/veh-mi (0.623 kwh/veh-km)
At Design Capacity . . . . . 1.1 kwh/veh-mi (0.685 kwh/veh-km)

STATIONS:

Type . . . . . On-line and off-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Ticket/credit card machines and turnstiles, if required
Security . . . . . TV surveillance at stations
Boarding Capacity . . . . . 1,800 psgr/hr/berth
Deboarding Capacity . . . . . 1,800 psgr/hr/berth
Max Wait Time . . . . . 2 min nominal
Vehicle in Station Dwell Time . . . . . 20 sec nominal
Average Station Spacing . . . . . 0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . Dependent on system layout
Stops . . . . . Non-stop or multi-stop
Accommodation . . . . . Seated and standing
Comfort . . . . . Vehicles heated and air conditioned
Security . . . . . 2-way communication, emergency signal and lighting, manual door, on-board fire extinquishers
Instruction . . . . . Graphic displays, including fixed and variable

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Power overload, fire control, anti-slip traction, station and vital interlocks, critical component detection vehicle diagnostics
Fail Operational Features . . . . . Propulsion, tires, brakes, power system, doors, control, air conditioning, and on-board batteries (not for propulsion)
Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Data unavailable
Strategy For Removal of Failed Vehicle . . . . . Vehicle is towed to station.
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Evacuation of passengers after vehicle is towed to station
System Lifetime . . . . . 30 years
Vehicle Lifetime . . . . . 1,600,000 mi (1.6 mi/km) 10 years

MAINTENANCE:

Data unavailable
Other Maintenance . . . . . 13 sensing devices to measure critical components, plus 11 advisory detection devices with signals communicated to central computer for diagnostic processing; periodic operation checkouts

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages, luggage, wheelchairs
Goods Movement . . . . . Interchangeable body to freight container

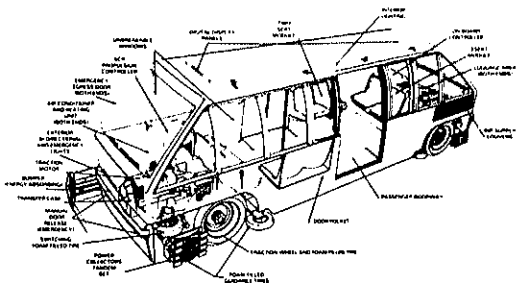
PERSONNEL REQUIREMENTS:

Typical System of 2 vehicles, 2 stations and 0.5 mi (0.8 km) of one-way guideway
No. of Operators/Vehicle . . . . . None
No. of Attendants/Station . . . . . None
No. of Central Control Attendants . . . . . One per shift

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	24.7 ft (7540 mm)
Overall Width	6.67 ft (2030 mm)
Overall Height	8.67 ft (2640 mm)
Empty Weight	13,230 lbs (6000 kg)
Gross Weight	18,522 lbs (8400 kg)
Passenger Space (Design Load)	3.9 ft^2 (0.36 m^2) seated 2.5 ft^2 (0.23 m^2) standing
Doorway Width	41 in (1040 mm)
Doorway Height	80 in (2030 mm)
Step Height	Less than 1.0 in (less than 25.4 mm)



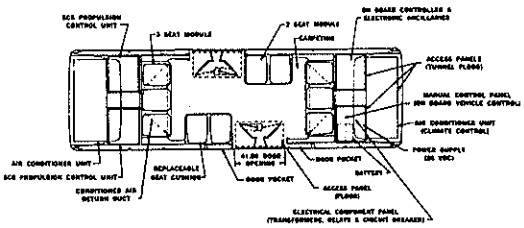
VEHICLE CUT-AWAY

SUSPENSION:

Type	Supported below on foam filled rubber tires, coil springs, shock absorbers, torque arm control
Design Load	9,261 lbs (4200 kg)/front suspension 9,261 lbs (4200 kg)/rear suspension
Lateral Guidance	Direct acting double wagon steering via constrained lateral guidewheels

PROPULSION & BRAKING:

Type & No. Motors	dc rotary electric, 480 vdc - 2 per vehicle
Motor Placement	One per axle
Motor Rating	60 HP, 45 kw at 2,500 rpm
Type Drive	Transfer case and differential
Gear Ratio	6.837:1
Type Power	480 vac (dc) 3ϕ, 1500 max amps (short term peak)
Power Collection	Guideway power rails, 4 collector assemblies/vehicle
Type Service Brakes	Regenerative to zero velocity, friction for holding
Type Emergency Brakes	Friction
Emergency Brake Reaction Time	1.75 sec



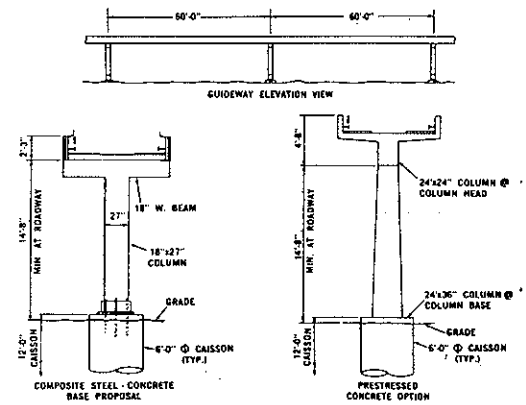
VEHICLE LAYOUT

SWITCHING:

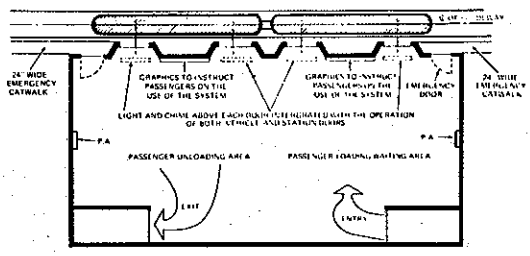
Type & Emplacement	Mechanical positive entrapment switching wheels; on-board vehicle wheels and passive guideway rails
Switch Time (lock-to-lock)	2 sec
Speed Thru Switch	30 mph (48 km/h) max
Headway Thru Switch	20 sec min

GUIDEWAY:

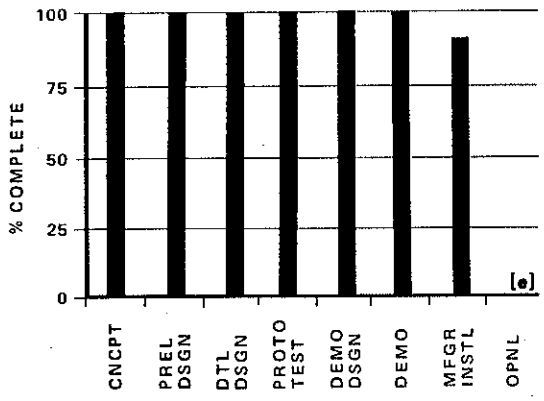
Type	U-shaped running surface, with vertical side walls for guidance can be built at, above or below-grade
Materials	Pre-stressed concrete, steel, or steel/concrete composition
Running Surface Width	7.7 ft (2340 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	120 ft (36.5 m)
Overall Cross Section Width	At-grade 10 ft (3050 mm) elevated 12 ft (3658 mm)
Overall Cross Section Height	2.25 ft (686 mm)
Design Load	1,000 lbs/ft (1480 kg/m)
Double Lane Elevated Guideway:	
Max Elevated Span	120 ft (36.6 m)
Overall Cross Section Width	At-grade 22 ft (6706 mm) elevated 26 ft (7925 mm)
Overall Cross Section Height	2.25 ft (0.69 m) (steel/concrete composition) 2.17 ft (0.66 m) (pre-stressed concrete)
Design Load	2,000 lbs/ft (2960 kg/m)
Guideway Passenger Emergency Egress	Egress from either end of vehicle onto guideway surface; guideway power is removed when vehicle emergency doors are opened.
Type Elevated Guideway Support Columns	Concrete



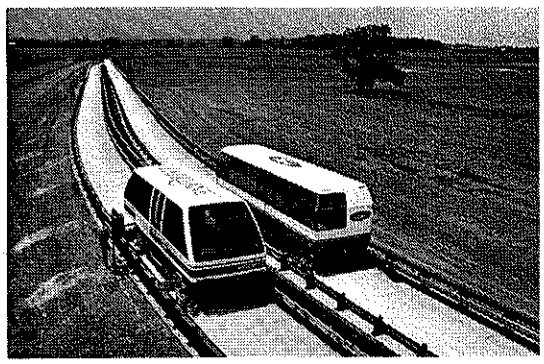
ELEVATED GUIDEWAY CROSS SECTIONS



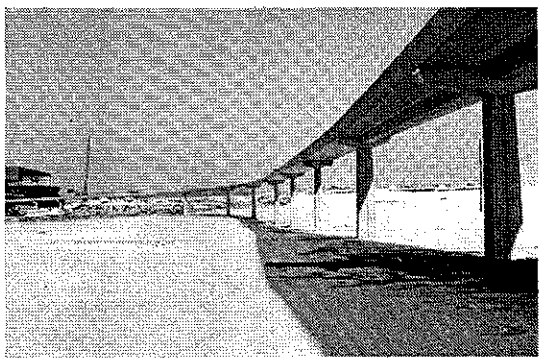
EXAMPLE STATION LAYOUT



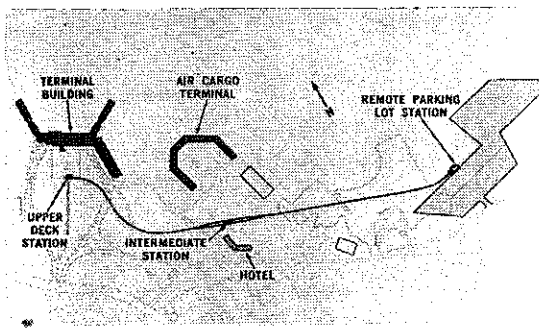
DEVELOPMENT STATUS



MULTIPLE VEHICLE TESTING



FAIRLANE ELEVATED GUIDEWAY



BRADLEY SYSTEM ALIGNMENT

CONTROL:

Fully automatic fixed block controls employ metallic signal rails and proven failsafe techniques. Vehicle positions are detected continuously via the signal rails and full speed operation is maintained as long as no conflicts exist. The attainment of high performance operation is enhanced via the use of an on-board computer, which precisely regulates vehicle propulsion torque so as to attain accurate vehicle arrival times at critical locations. Failsafe equipment is provided for vehicle detection, overspeed, direction, switching, end of guideway protection, and vehicle and station door controls. Non-vital functions are performed by computers, which provide the flexibility via minor programming changes to adapt to variations from application to application.

STATIONS:

Completely enclosed including passenger boarding area, doors, and door control mechanisms, and communication services providing passenger interface; station waiting area is nomially designed to accommodate 60 passengers.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The ACT System was developed by the Ford Motor Company in Dearborn, Michigan, from private funds. Development began in late 1970. The system was successfully demonstrated at Transpo '72, Dulles Airport, Washington, D.C., in May, 1972, where 2 vehicles carried 25,000 passengers over a 10 day period. The system was acknowledged to have met all the Transpo '72 objectives as outlined by the U.S. Urban Mass Transportation Administration. At present, the system is available for installation and firm price quotations are available from the developer.

INSTALLATIONS & CONTRACTS:

Cherry Hill Test Facility — Single elevated and at-grade guideway loop of 0.76 mi (1.2 km) with a 6% grade, one off-line station, and a maintenance building

Fairlane Shopping Center, Dearborn, Michigan — A 0.5 mi (1.61 km) system presently under construction for $4.5 million

Bradley International Airport, Hartford, Connecticut — System at $4.5 million for 2 vehicle shuttle system of 0.69 mi (1.1 km) to connect parking lot with terminal (contract signed August, 1973)

COSTS:

Dependent upon specific site applications, may average $9-10 million/mi ($5.6-6.2 million/km) for double guideway, vehicles, and stations [f]

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	10 ft (3.05 m)
Single Lane Guideway Envelope Height	10 ft (3.05 m)
Single Lane Guideway Structural Weight	1,200 lbs/ft (1800 kg/m)
Double Lane Guideway Structural Weight	2,400 lbs/ft (3600 kg/m)
Max Grade	10%
Min Vertical Turn Radius	100 ft (30.6 m) at reduced speed
Min Horizontal Turn Radius	50 ft (15.3 m) at reduced speed
Construction Process	Prefabricated and cast in place concrete
Staging Capability	Sections could be operated while others under construction.

LIMITATIONS:

Overall size of vehicle and guideway limits retrofit installations to uncrowded sites unless major modifications are made to surrounding structures. [e]

Permission of standees limits service accel/decel to 4.4 ft/s^2 (1.34 m/s^2) [e]

Operational Temperature Range of -40° to 120° F (-40° to 49° C)

ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emissions

Visual, Single Lane Elevated Guideway . . . . . .

H_1 — 4.67 ft (1420 mm), H_2 — 12 ft (3660 mm)
W_1 — 10 ft (3050 mm), W_2 — 10 ft (3050 mm)
P_1 — 8.5 ft (2590 mm), P_2 — 12.5 ft (3810 mm)

Noise . . . . . .Data unavailable

AIRTRANS
(INTRA AIRPORT TRANSPORTATION SYSTEM)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: LTV Aerospace Corporation
Vought Systems Division
Post Office Box 5907
Dallas, Texas 75222
U.S.A.
Tel: (214) 266-5634

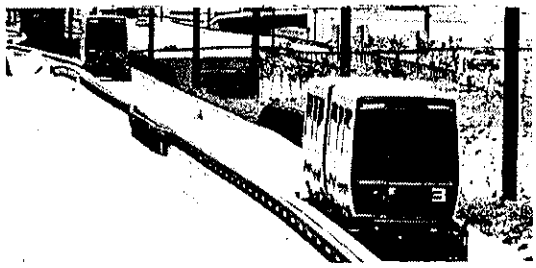
LICENSEES: Niigata, Engineering, Japan
Comsip Enterprises, France
(See data sheets on NTS system, this issue)

PATENTS: Guide Following Steering Apparatus No. 3796165; Guideway Switching System No. 3782292; Photo-Electric Leveling System No. 3765692; Safety Circuit-Electrically Powered Vehicle No. 3762515; Steering System for Self-Guiding Vehicle No. 3872704; Steering System-Reversal Actuator No. 3858523

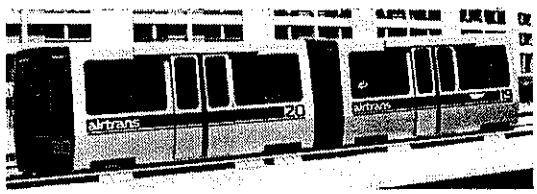
DATA REFERENCE CODE: [a 91: except as noted]

SYSTEM DESCRIPTION:

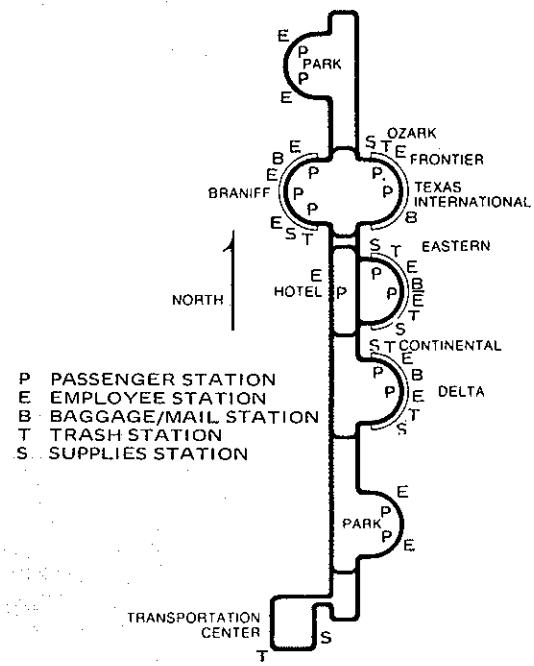
AIRTRANS is a completely automated Light Guideway Transit system specifically designed as the ground transportation system, serving passengers, personnel, baggage, mail, supplies and refuse removal for the new 9 x 5-mile (14.5 x 8 km) Dallas/Fort Worth, Texas, Airport. Driverless vehicles operate as single units or in pairs (future expansion to triplet) as a collection and distribution system with both on-line and off-line stations. The network covers a limited area with exclusive guideways. Routes and schedules are fixed; however, changes can be commanded by a central automatic controller. The system has been designed for easy expansion to accommodate future airport growth.



TYPICAL INSTALLATION
DALLAS/FORT WORTH AIRPORT



VIEW OF VEHICLES



NETWORK

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

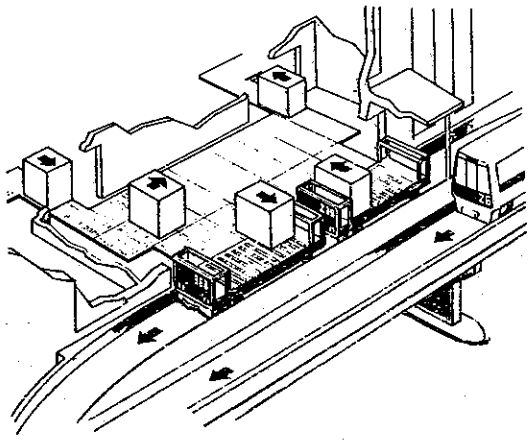
Max Theoretical One-Way Capacity	12,000 psgr/hr
Max Practical One-Way Capacity	9,000 psgr/hr
Min Theoretical Headway	12 sec
Min Practical Headway	18 sec
Availability	Fixed scheduled, programable
Type Service	Multi-route collection and distribution in limited area
Type Network	Grid with 17 interacting routes
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles or 2-car trains

VEHICLE PERFORMANCE:

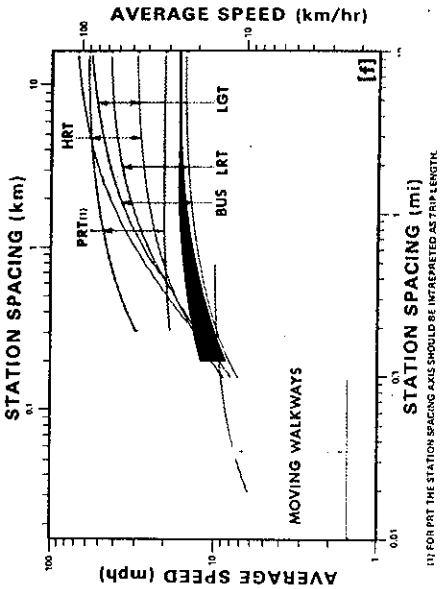
Cruise Velocity	17.0 mph (27.4 km/h)
Max Velocity	19.0 mph (30.58 km/h)
Max Grade	7.8%

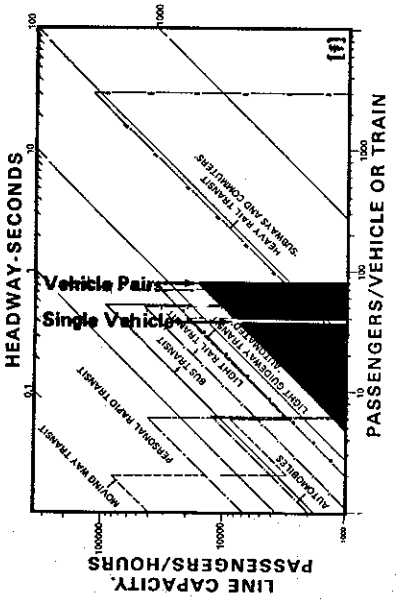
PUBLISHER'S NOTE:

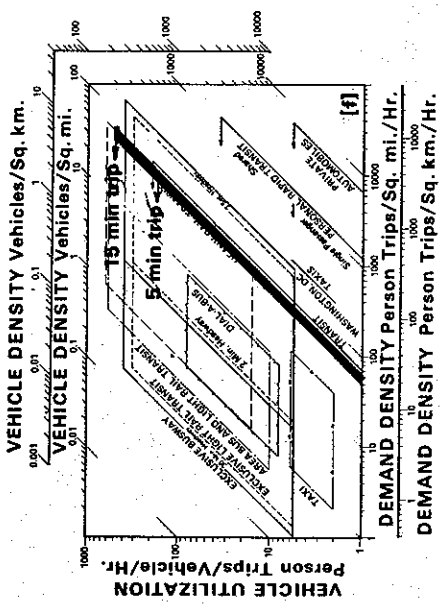
These data sheets are prepared as a description of the Dallas-Fort Worth Airport installation. Because of limited space no attempt has been made to report the range of operational characteristics, etc., which may be available should it be considered for another site-specific installation.



CARGO HANDLING







Service Acceleration	3.38 ft/s^2 (1.03 m/s^2)
Service Deceleration	3.38 ft/s^2 (1.03 m/s^2)
Max Jerk	2.5 ft/s^3 (0.76 m/s^3)
Emergency Decel	6.9 ft/s^2 (2.10 m/s^2)
Stopping Precision in Station	±12.0 in (304.8 mm)
Degradation if Guideway is Wet	None
Degradation for Ice & Snow	Velocity reduced to 9.54 mph (15.3 km/h) if required
Vehicle Design Capacity	16 seated 24 standing
Vehicle Crush Capacity	16 seated 44 standing
Average Energy Consumption for first 12 months of Operation	2.38 mph/veh-mi (1.48 kwh/veh-km)

STATIONS:

Type	Four on-line and 49 off-line
Type Boarding	Level
Ticket or Fare Collection	Coin turnstile
Security	TV monitors, two-way voice and station attendants
Boarding Capacity	4,000 psgr/hr
Deboarding Capacity	4,000 psgr/hr
Max Wait Time	2 min
Vehicle in Station Dwell Time	18 sec
Average Station Spacing	0.34 mi (0.55 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles.
Transfers	None
Stops	Stops at each station on most routes; station by-pass capability exists.
Accommodation	Seated and standing
Comfort	Enclosed, constant temperature (year-round)
Security	2 way voice communications, audio monitoring
Instruction	Route maps, destination graphics, and automatic station announcements on-board

RELIABILITY & SAFETY:

Fail Safe Features	Overspeed, loss of signal, power failure, short headways, unscheduled door opening and others
Fail Operational Features	Computers, loss of radio communications, loss of environmental control
Total System Availability	Not less than 99% for 6 months
System Restore Time After Failure	0.5 hrs
Station Mean Time Before Failure	Data unavailable
Station Restore Time After Failure	Data unavailable
Vehicle Mean Time Before Failure	500 hrs
Strategy For Removal of Failed Vehicle	Three-part plan: 1. Manually reset vehicle automatic control 2. Manually drive vehicle out of guideway system 3. Use one of seven retrieval tugs
Strategy For Passenger Evacuation of Failed Vehicle	Tug vehicle to station or evacuate through end doors and walk down channel-shaped guideway
System Lifetime	30 years
Vehicle Lifetime	20 years

MAINTENANCE:

Inspection Frequency	
Guideway	Daily
Station	Daily
Vehicle	Daily
Periodic Maintenance	
Guideway	Weekly
Station	Weekly
Vehicle	Daily
Adjustments Required	Periodic checklist
Other Maintenance	As required

CARGO CAPABILITY:

Passenger Articles	Luggage rack and garment bag hanger
Goods Movement	Specialized containers and utility vehicles for handling mail, supplies and trash automatic load and unload

PERSONNEL REQUIREMENTS:

System of 68 vehicles, 53 stations and 13 mi (20.9 km) of one-way guideway

No. of Operators/Vehicle	None
No. of Attendants/Station	None
No. of Administrative Personnel	2
No. of Central Control Personnel	3/shift
No. of Maintenance Personnel	85
Engineering Staff	2 supervisory

PHYSICAL DESCRIPTION

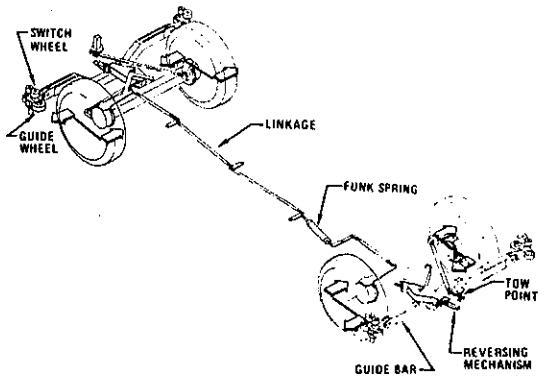
VEHICLE:

Overall Length . . . . . 21 ft (6401 mm)
Overall Width . . . . . 7 ft (2134 mm)
Overall Height . . . . . 10 ft (3048 mm)
Empty Weight . . . . . 14,000 lbs (6349 kg)
Gross Weight . . . . . 20,800 lbs (9433 kg)
Passenger Space (Design Load) . . . . . 3.0 ft^2 (0.28 m^2) seated
2.5 ft^2 (0.23 m^2) standing
Doorway Width . . . . . 54.0 in (1372 mm)
Doorway Height . . . . . 76.0 in (1931 mm)
Step Height . . . . . Level

PASSENGER VEHICLES
AT CHECKOUT STATION

SUSPENSION:

Type . . . . . Four foam-filled rubber tires and air bag suspenion
Design Load . . . . . 2500 lbs (1134 kg)/front suspension
Lateral Guidance . . . . . Double Ackerman actuated by guidewheels



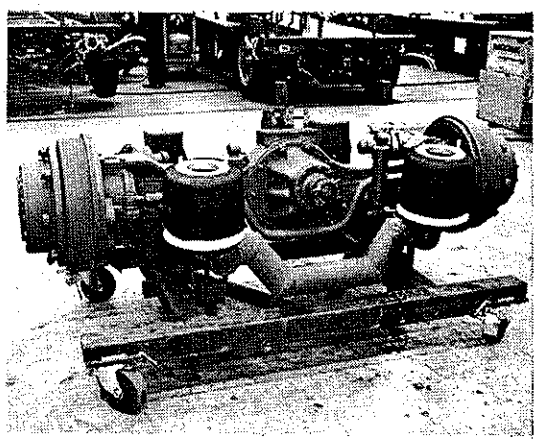
STEERING SYSTEM

PROPULSION & BRAKING:

Type & No. Motors . . . . . Rotary dc electric motor, drive shaft, differential
Motor Placement . . . . . On-board vehicle
Motor Rating . . . . . 60 HP, at 2736 rpm
Type Drive . . . . . Direct
Gear Ratio 1:7.44
Type Power . . . . . 480 vac 3ϕ 250 amps
Power Collection . . . . . Articulated brushes
Type Service Brakes . . . Internal expending drum, air actuated wedge
Type Emergency Brakes . . Same as service brakes but spring operated
Emergency Brake Reaction Time . . . . . 0.8 sec

SWITCHING:

Type & Emplacement . . Mechanical switch blade on guideway entraps vehicle guidewheels
Switch Time (lock-to-lock) . . . . . 3 sec
Speed Thru Switch . . . . . 17 mph (27.4 km/h) max
Headway Thru Switch . . . . . 20 sec min



SUSPENSION SYSTEM

GUIDEWAY:

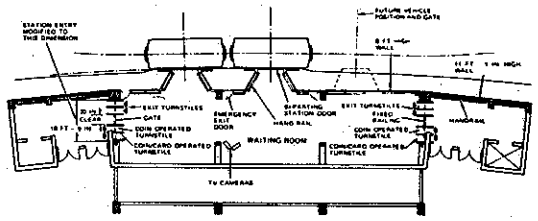
Type . . . . . At-grade and above-grade U-shaped roadway
Materials . . . . . Reinforced concrete
Running Surface Width . . . . . 8.17 ft (2490.2 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 120 ft (36580 mm)
Overall Cross Section Width . . . . . 9 ft (2743 mm)
Overall Cross Section Height . . . . . 2.67 ft (814 mm)
Design Load . . . . . 908 lbs/ft (1351 kg/m)
Guideway Passenger Emergency Egress . . . . . Two end emergency doors plus side service door
Type Elevated Guideway Support Columns . . . . Pre-cast pre-stressed concrete

CONTROL:

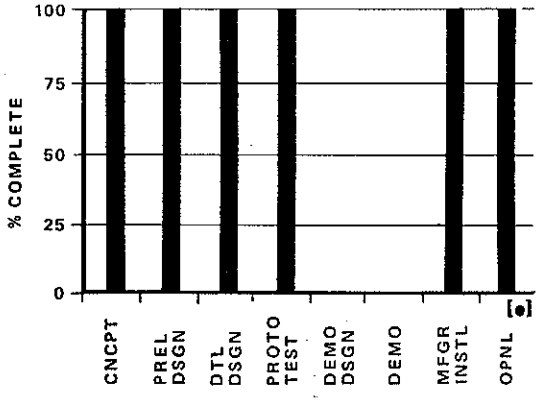
A quasi-synchronous automatic system (fixed schedule); headway is controlled through a fixed-block system (5 block separation) and an independent automatic vehicle protection system for collision avoidance. Central computer supervises all traffic, monitors system status, commands speed, switch points, dispatching, and routing, and controls bunching. Vehicle computer controls route, stopping, position, door controls, and speed. General railway signal equipment is used.

STATIONS:

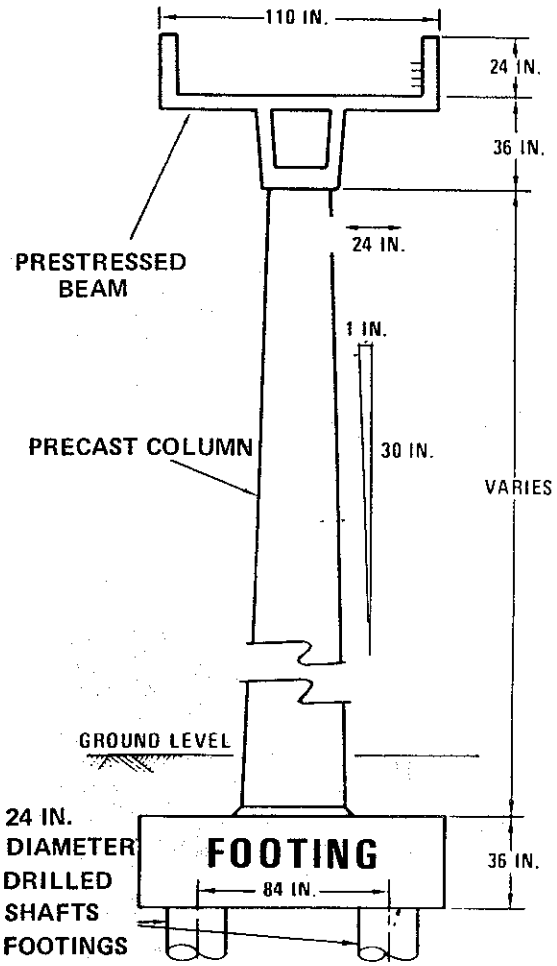
Stations are nominally 80 ft (24.4 m) long by 20 ft (6.1 m) wide with two berths. Separate station facilities are provided; one for airport patrons and one for airport personnel.



STATION LAYOUT



DEVELOPMENT STATUS



ELEVATED GUIDEWAY CROSS SECTION

DEVELOPMENT HISTORY, PLANS & PROGRESS:

System is operational. Since start of service on January 13, 1974, thru May 7, 1975, system has carried 4,000,000 passengers. Vehicles have accumulated 4,300,000 miles. Presently it runs 10,000 miles per day.

INSTALLATIONS & CONTRACTS: Dallas/Fort Worth, Texas Airport

The system contains 13 mi (21 km) one-way guideway, 51 passenger vehicles, 17 utility vehicles, 14 passenger stations, 5 baggage/mail stops, 9 supply stops, 9 trash stops, a central control facility, and a general maintenance facility. Of the guideway, 20% is above-grade and 80% at-grade.

COSTS: [b 10]

Total systems design and construction contract = $35.3 million (exclusive of construction claims in excess of $18 million)

Maintenance Costs . . . . . .$4.9 million for three-year contract ($0.45/veh/mi) [e]

INSTALLATION OR RETROFIT CAPABILITY:

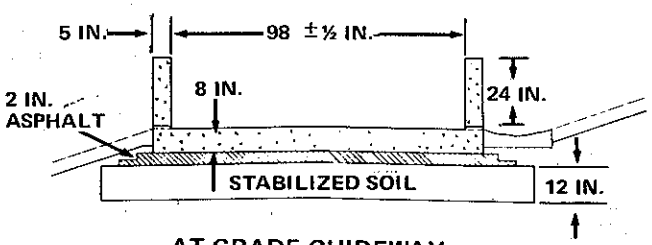
Single Lane Guideway Envelope Width . . . . . 9.0 ft (2743.2 mm)
Single Lane Guideway Envelope Height . . . . . 12.0 ft (3657.6 mm)
Single Lane Guideway Structural Weight . . . . . 1,400.0 lbs/ft (2082.7 kg/m)
Double Lane Guideway Structural Weight . . . . . Not applicable
Max Grade 8%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 100.0 ft (30.48 m) at 17.0 mph (27.36 km/h)
Construction Process . . . . . Precast beams for elevated guideway, other sections poured in place
Staging Capability . . . Expandable without removal or shutting down

LIMITATIONS: [e]

The 5 block system of headway control would preclude shortening headway for future increases in line capacity (i.e., trains/hr). It would also preclude increasing line velocity. Control system and software would require redesign for demand service operation.

ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 5 ft (1524 mm), H_2 – 13 ft (3962.4 mm)
W_1 – 9 ft (2743 mm), W_2 – 9 ft (2743 mm)
P_1 – 8.2 ft (2500 mm), P_2 – 13.2 ft (4023.4 mm)
Noise . . . . . .NCA 55 inside vehicle
NCA 70 at 5.0 ft (1.53 m) to side



AT-GRADE GUIDEWAY CROSS SECTION

DASHAVEYOR

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: The Dashaveyor Company
A Subsidiary of the Bendix Corporation
3300 Plymouth Road
Ann Arbor, Michigan 48107
U.S.A.
Tel: (313) 665-7766
Telex: 810-223-6041 (BX SYS DV AA)

LICENSEES: None

PATENTS: 3,384,031-Railway Transportation System; 3,429,180-Rack and Pinion Vehicle Propulsion System; 3,528,608-Expansion Joint; 3,540,380-Articulated Railway Transportation System; 3,552,692-Railway Control System; 3,594,572-Wayside Control System; 3,637,957-Expansion Joint; 3,648,617-Improvement in Traction Devices. Also patented in major foreign countries. A number of other patent applications pending.

DATA REFERENCE CODE: [a: except as noted]

SYSTEM DESCRIPTION:
The systems offered are for limited area collection/distribution or line-haul transportation of people and goods. The system is totally automated, operating rubber-tired vehicles over exclusive guideways between on-line and/or off-line stations. Service can be either scheduled or on-demand as required.

The system design is based on a family of modularized subsystems and components. Two basic vehicles are offered, steel or concrete guideways for both at-grade and above-grade installation, side rail guidance, and a full range of control modules for automatic train or vehicle operation, protection, and supervision.

Family I vehicle is designed for use in major activity centers, while the Family II vehicle is for use in line-haul regional applications.

OPERATIONAL CHARACTERISTICS

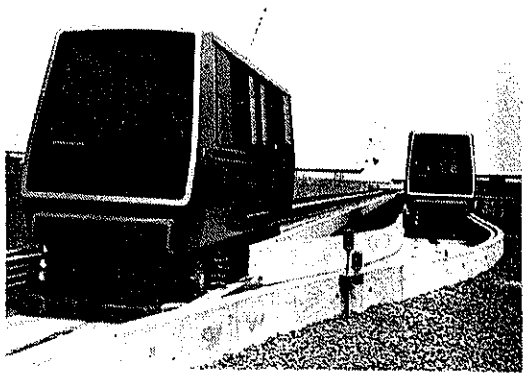
SYSTEM PERFORMANCE: [a 71]

Max Theoretical One-Way Capacity	(I)* - 1,500 to 12,000 psgr/hr (II)* - 2,000 to 2,400 psgr/hr
Max Practical One-Way Capacity	(I) - 1,200 to 9,600 psgr/hr (II) - 1,600 to 19,200 psgr/hr
Min Theoretical Headway	15 sec
Min Practical Headway	18 sec
Availability	Either scheduled or on-demand
Type Service	Limited area collection and distribution or line-haul transportation of people and goods
Type Network	Limited area, line-haul, or loops
Type of Vehicle Routing	Fixed or variable [e]
Traveling Unit	Single vehicles or up to 4-vehicle trains

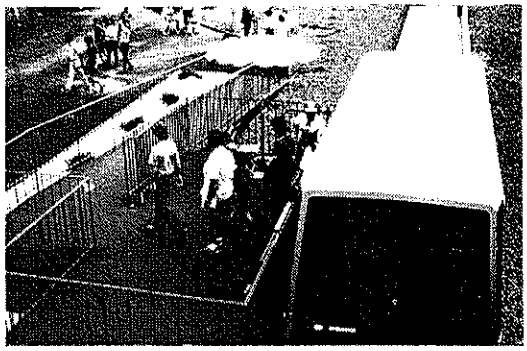
***(I) = Family I Vehicle**
(II) = Family II Vehicle

PUBLISHER'S NOTE:

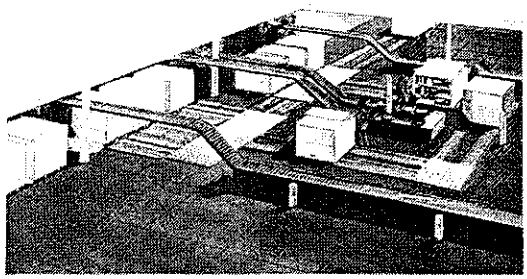
Because of the extensive line of subsystems and ranges offered, these data sheets are confined to essentially those offered as a result of the Transpo '72 installation experience (which is a prototype of the Family I class). The reader is advised that additional ranges and sizes of components may be available upon contacting the developer.



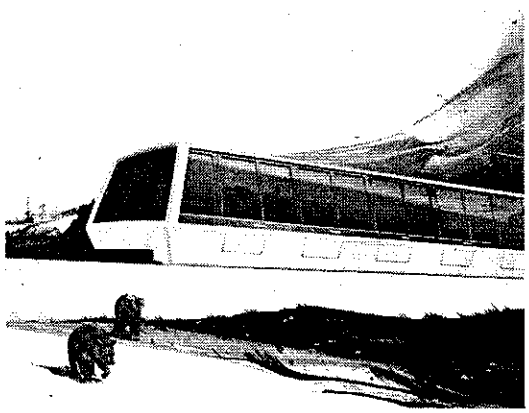
VEHICLES/GUIDEWAY
AT TRANSPO '72



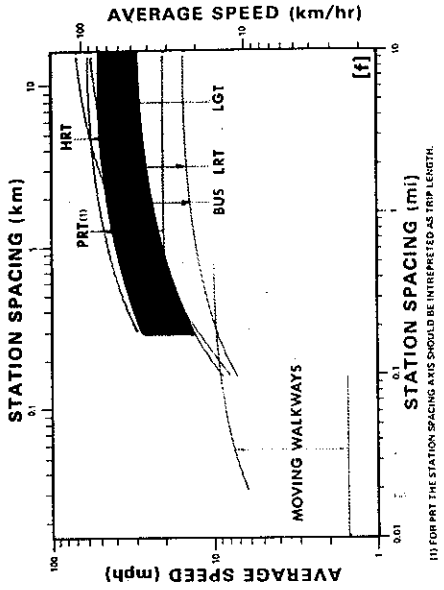
UNLOADING PLATFORM
AT TRANSPO '72

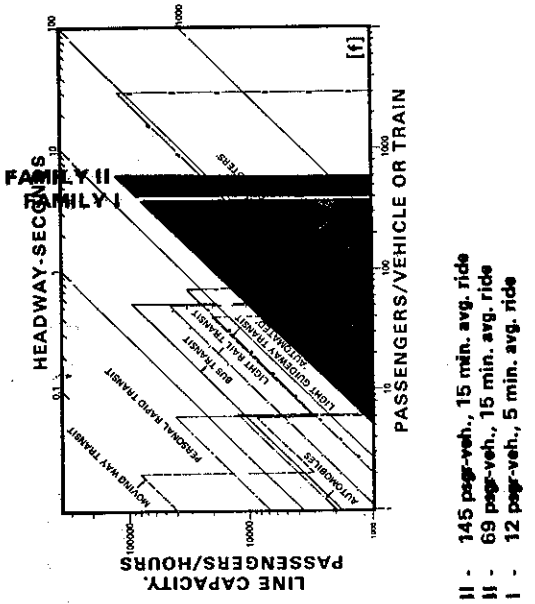


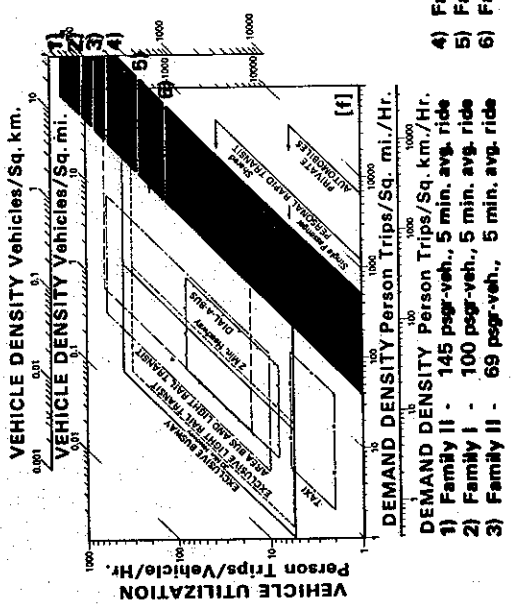
AUTOMATED CARGO HANDLING



TORONTO ZOO APPLICATION







VEHICLE PERFORMANCE: [a: 71] Family I/Family II

Cruise Velocity . . . . . 30/50 mph (48/80 km/h)
Max Velocity . . . . . 40/60 mph (64/96 km/h)
Max Grade 10%
Service Acceleration . . . . . 4.5 ft/s^2 (1.73 m/s^2)
Service Deceleration . . . . . 3.2 - 4.5 ft/s^2 (0.98 - 1.73 m/s^2)
Max Jerk . . . . . 3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel . . . . . 9.7 - 12.9 ft/s^2 (2.9 - 3.92 m/s^2)
Stopping Precision in Station . . . . . ±6 in (±150 mm)
Degradation if Guideway is Wet . . . . . Tests at Transpo '72 indicate negligible degradation
Degradation for Ice & Snow . . . . . Provisions for snow & ice removal: degraded speed command as required by severe weather
Vehicle Design Capacity . . . . . Family I – 12 - 40 seated 0 - 60 standing
Family II – 24 - 45 seated 45 - 100 standing
Energy Consumption . . . . .
(1) – 3 to 5 kwh/veh-mi (1.9-3.1 kwh/veh-km)
(2) – 5 to 7 kwh/veh-mi (3.1-4.4 kwh/veh-km)

STATIONS:

Type . . . . . One-line or off-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automated machines
Security . . . . . TV surveillance
Boarding Capacity . . . . . Variable, based on 2 psgr/sec/door
Deboarding Capacity . . . . . Variable, based on 2 psgr/sec/door
Max Wait Time . . . . . 15 sec
Vehicle in Station Dwell Time . . . . . Typically 15 to 20 sec, adjustable
Average Station Spacing . . . . . 0.19 - 0.95 mi (0.3 - 1.524 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicle.
Transfers . . . . . Not necessary
Stops . . . . . Yes, for scheduled; no, for demand mode
Accommodation . . . . . Seated and/or standing
Comfort . . . . . Vehicles heated and air conditioned
Security . . . . . Large windows, on-board emergency equipment
Instruction . . . . . Signs and active graphics

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Standard fail-safe design principles are applied throughout, including approved fail-safe compartments and circuits and fail-safe checked redundancy. Fault annunciation with automatic stop for Class I failures; totally independent collision avoidance or vehicle protection; interlocks on doors, speed, switches, routing, power, air, roll-back, train line, ground fault, tire pressure, drag

Fail Operational Features . . . . . Redundant control circuits with fault annunication; vehicles capable of pushing others; by-pass switches recommended in guideway layout; emergency power on vehicles

Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
} Subject to variation in specific applications. Generally, availability greater than 90% and MTTR approximately 30 min

Strategy For Removal of Failed Vehicle . . . . . Other vehicle can push failed vehicle

Strategy For Passenger Evacuation of Failed Vehicle . . . . . An emergency exit is provided on the side opposite the automatic door

System Lifetime
Vehicle Lifetime
} . . . . . Depending on application.

MAINTENANCE:

System includes off-line storage and maintenance with transfer table, cleaning and repair facilities, service vehicle, and pre-operational checkout equipment. Operation and maintenance offered with system.

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages, luggage, wheelchairs
Goods Movement . . . . . Automated cargo handling is proposed.

PERSONNEL REQUIREMENTS: [e]

Because of highly automated operation, man power requirements can be expected to be low.

PHYSICAL DESCRIPTION

VEHICLE: [a 71]

Overall Length . . . . . (I) - 22 to 30 ft (6.7-9.1 m); (II) - 30 to 42 ft (9.1-12.8 m) in modules
Overall Width . . . . . (I) - 7 ft (2100 mm); (II) - 9 ft (2700 mm)
Overall Height . . . . . (I or II) - 10 ft (3050 mm)
Empty Weight . . . . . (I) - 15,000 to 20,000 lbs (6818 - 9091 kg); (II) - 18,000 to 24,000 lbs (8182 - 10909 kg)
Gross Weight . . . . . (I) - 20,000 to 30,000 lbs (9091 - 13636 kg); (II) - 25,000 to 40,000 lbs (11364 - 18182 kg)
Passenger Space (Design Load) . . . . . 5 ft^2 (0.46 m^2) seated 3 ft^2 (0.28 m^2) standing
Doorway Width . . . . . Biparting door; 72 in (1829 mm), emergency door; 24 in (609 mm)
Doorway Height . . . . . 75.6 in (1920 mm)
Step Height . . . . . Level

SUSPENSION: [a 71]

Type . . . . . Supported on polyfoam filled or pneumatic rubber tires, air leveling and coil springs
Design Load . . . . . (I) - 6,500 lbs (2955 kg); (II) - 8,000 lbs (3636 kg)
Lateral Guidance . . . . . Double-wagon actuated via constrained lateral hard rubber or foam filled tires; adjustable spring hydraulic or mechanical load absorbers.

PROPULSION & BRAKING: [a 71]

Type & No. Motors . . . . . Conventional rotory dc electric motor
Motor Placement . . . . . One or two traction drive units under floor
Motor Rating . . . . . 25 - 125 HP
Type Drive . . . . . Positive traction differential
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 480 vac 3ϕ - SCR converters each vehicle; or 600 vdc alternative
Power Collection . . . . . Power rails - 4 collector assemblies/vehicle
Type Service Brakes . . . . . Controlled friction brakes, pneumatic or pneumatic/hydraulic; dynamic braking optional
Type Emergency Brakes . . . . . Application of calipers to disc brake, mechanical with pneumatic hold-off
Emergency Brake Reaction Time . . . . . 0.6 sec

SWITCHING: [a 71]

Type & Emplacement . . . . . Optional: (a) I-beam in running surface with entrapment of lateral guidewheels; or (b) sidewall blade entrapment
Switch Time (lock-to-lock) . . . . . Less than 1 sec
Speed Thru Switch . . . . . 40 mph (64 km/h) max
Headway Thru Switch . . . . . Approx 2 sec min

GUIDEWAY: [a 71]

Type . . . . . At-grade or above-grade U-shaped roadway surface with side walls
Materials . . . . . Steel or reinforced concrete
Running Surface Width . . . . . (I) 6.67 ft (2033 mm); (II) 8.17 ft (2490 mm)

Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 60 - 120 ft (18288 - 36576 mm)
- Overall Cross Section Width . . . . . (I) 8.3 ft (2530 mm); (II) 9.3 ft (2835 mm)
- Overall Cross Section Height . . . . . 5 ft (1524 mm) max
- Design Load . . . . . Data unavailable

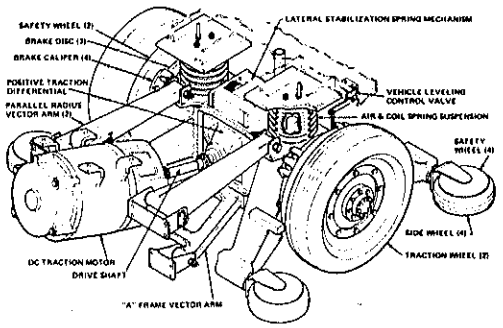
Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 60 - 120 ft (18288 - 36576 mm)
- Overall Cross Section Width . . . . . (I) - 19.8 ft (6030 mm); (II) - 22 ft (6690 mm)
- Overall Cross Section Height . . . . . 5 ft (1524 mm) max
- Design Load . . . . . Data unavailable

Guideway Passenger Emergency Egress . . . . . Information unavailable
Type Elevated Guideway Support Columns . . . . . Concrete or steel columns

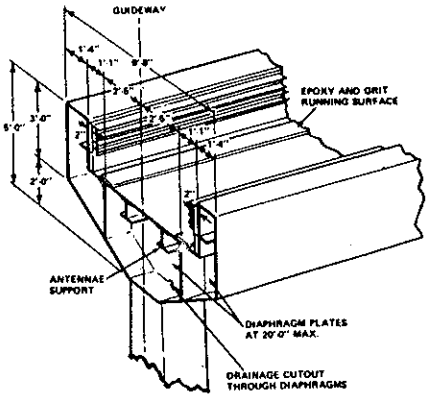
CONTROL:

Control is customized to each application from modular components. Two basic types have been developed: (a) used in varying form in Morgantown, Las Vegas Proposal, Control Test Facility; (b) used in varying form in TRANSPO '72, Toronto Zoo, Newark ITTS proposal.

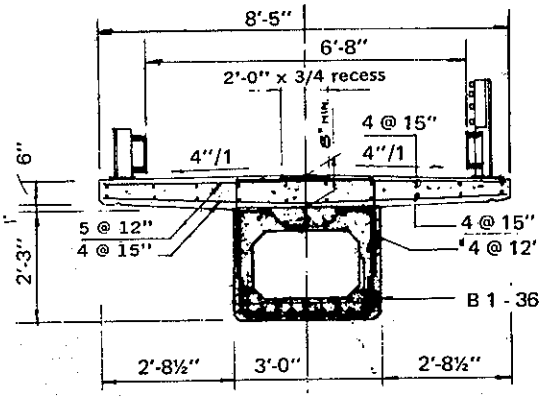
(a) Quasi-synchronous point follower with elements at central, regional, and vehicles; central uses redundant computers. Regional uses computers and/or hard-wired logic. Central commands dispatch, route, synchronism, station doors, empty vehicle management, monitors faults, processes demand requests, provides passenger display data, central monitor functions. Regional processes, decodes



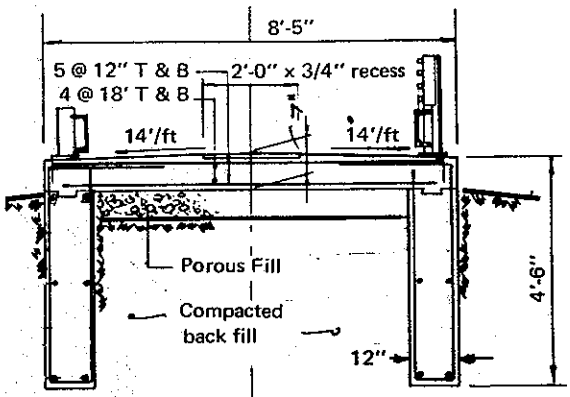
TRANSPO '72 PROPULSION AND SUSPENSION



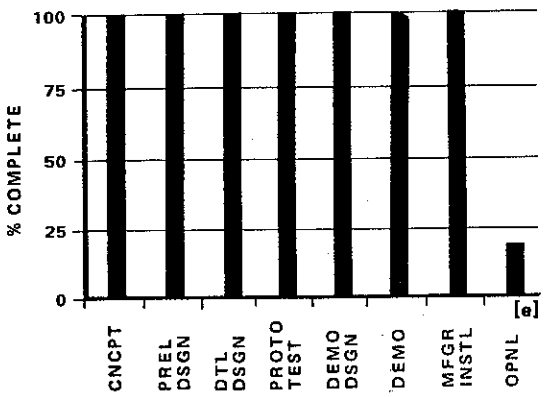
SINGLE ELEVATED STEEL GUIDEWAY



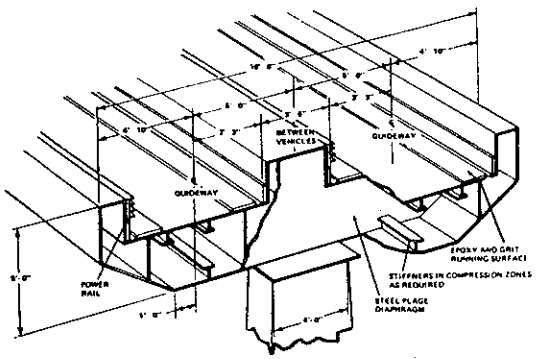
SINGLE ELEVATED CONCRETE GUIDEWAY



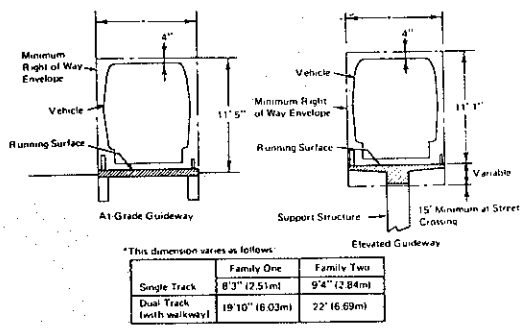
SINGLE AT-GRADE CONCRETE GUIDEWAY



DEVELOPMENT STATUS



DOUBLE ELEVATED STEEL GUIDEWAY



*This dimension varies as follows:

	Family One	Family Two
Single Track	8'3" (2.51m)	9'4" (2.84m)
Dual Track (with walkway)	19'10" (6.03m)	22' (6.69m)

SINGLE GUIDWAY INSTALLATION ENVELOPES

and routes messages, monitors vehicle locations, provides independent collision avoidance. Vehicle electronics includes normal ATO functions. Passive position indicators and/or wayside detection used. Induction communications or signal rail used. FSK communications for non-vital functions.

(b) Fixed-block, continuous detection. Central performs line supervision including operator monitors and dwell time adjustment. Station (regional) and wayside performs train protection, some ATO functions, some local line supervision functions including position monitoring and performs normal ATO function. Induction communication or signal rail is used. FSK communications are used for non-vital functions.

Back-up, secure on-board manual control equipment is on vehicles.

STATIONS:

Stations may be on-line or off-line, enclosed or open, with or without automatic bi-parting doors. If used, doors should open to approx 7 ft (2.13 m) or more.

Station design is customized to application. Berth size approx equal to a vehicle length.

DEVELOPMENT HISTORY, PLANS & PROGRESS: [b]

Current design is third generation. First design (1970) was under contract with Dallas/ft. Worth Regional Airport Board for construction of a full-scale prototype at Pomona, California, featuring 1,236 ft (400 m) guideway, two 24-psgr vehicles 30 mph (48 km/h) max velocity, 25 sec headway, on-board switching, automatic, remote, and manual control. Second generation was the Transpo '72 system and third generation as shown for Toronto Zoo application. In addition, Bendix is the Command & Control system subcontractor to Boeing for Morgantown and to Rohr for urban TACV control system. A command and control test track and facility, located at Ann Arbor, Michigan, is being expanded to test full systems.

Editor understands there is no development activity presently underway [e].

INSTALLATIONS & CONTRACTS: [b]

TRANSPO '72: (Now dismantled) 1,275 ft (390 m) of single at-grade guideway, two 31-psgr vehicles, 3 station, 4 guideway diverter switches, 20 mph (32 km/hr) velocity. System carried 36,000 psgrs in 10 days. An extensive test program was carried out by UMTA following exposition.

TORONTO ZOO: (under construction) 3 miles of single guideway, 4 stations, 24 40-psgr Family I vehicle for 2 and 4 vehicle trains, to be operational late 1975, $12 million

TEST TRACK: Is installed at Ann Arbor, Michigan

COSTS: [b 21]

Capital . . . . . System - $2 to 8 million/mi ($1.24-4.97 million/km)
Vehicles - (I) $75,000 to $125,000; (II) $100,000 to $150,000
Operational Maintenance . . . . . Ranges between $0.50 to $1.00/veh-mi (0.31 - $0.62/veh-km) dependent upon specific installation

INSTALLATION OR RETROFIT CAPABILITY: [b]

Single Lane Guideway Envelope Width, Single Lane Guideway Envelope Height . . . . . See dimension drawings at left
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 10%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 74.8 ft (22.8 m) at 10 mph (16 km/h)
Construction Process . . . . . At-grade, pour-in-place; elevated prefabricated steel or prestressed concrete in single or double guideway configuration
Staging Capability . . . . . Fully modular subsystems and components

LIMITATIONS: [e]

Fixed-block control system limits reduction of headway to approx 3 sec. Guideway width and turning radius would limit installations in confined areas. General installations limited to limited areas or as a line-haul system.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual . . . . . Single elevated concrete guideway [f]
H_1 - (I & II): 4.5 ft (1.37 m); H_2 - (I & II): 13.3 ft (4.05 m)
W_1 & W_2 - (I): 8.25 ft (2.51 m), (II): 9.3 ft (2.83 m)
P_1 - (I): 7.3 ft (2.22 m), P_2 - (I): 13.2 ft (4.02 m)
P_1 - (II): 8 ft (2.44 m), P_2 - (II): 14 ft (4.27 m)
Noise . . . . . Exterior - NCA 60 at 25 ft (7.5 m) from guideway
Interior - NCA 60 and PSIL less than 65 dbA [a 7]

GEC MINITRAM

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

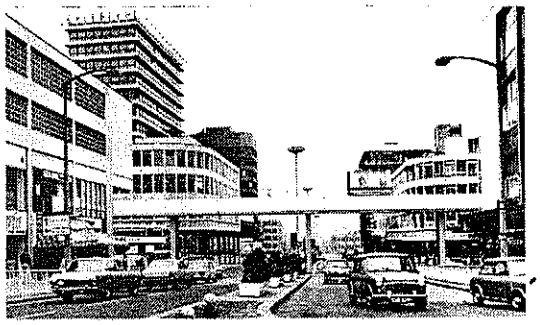
DEVELOPER: EASAMS Ltd. (a GEC Company)
Lyon Way
Frimely
Camberley
Surrey, GU16 5EX
England
Tel: Camberley 63377
Telex: 858115

LICENSEES: Data unavailable

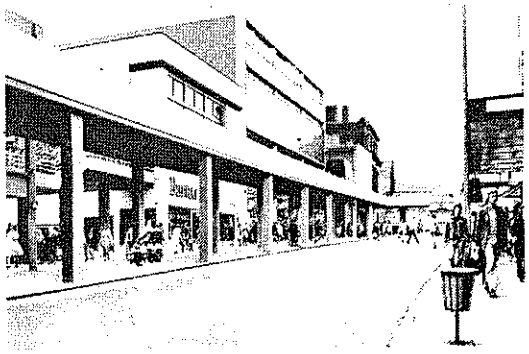
PATENTS: Data unavailable

DATA REFERENCE CODE: [a 21]

"EASAMS Copyright."
GEC MINITRAM MODEL ON GUIDEWAY



"Crown Copyright, prepared by Robert Matthew, Johnson-Marshall and Partners Ltd."
TYPICAL INSTALLATION



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TYPICAL INSTALLATION

"Crown Copyright, prepared by Robert Matthew, Johnson-Marshall and Partners Ltd."
PROPOSED INSTALLATION IN SHEFFIELD

SYSTEM DESCRIPTION:

The Minitram concept is of small automatically controlled, driverless vehicles running on their own track. Minitram may be operated as a scheduled line haul service with vehicles stopping at every station, or as an express service.

Single vehicles may be coupled into trains of up to 3 vehicles to ensure high capacity at peak periods and still maintain frequent service at off-peak periods.

The ability of negotiating tight curves and steep grades, and the ease of running at, above, and below-grade ensures that the Minitram system can be easily accommodated into the existing urban structure. In addition to the small vehicles described, larger vehicles with capacities of up to 100 passengers can be offered with the same performance.

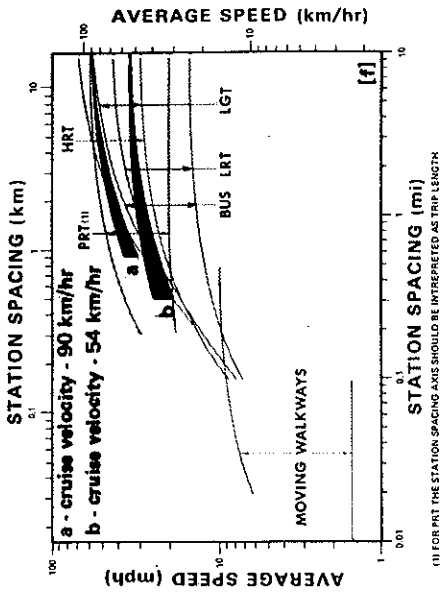
OPERATIONAL CHARACTERISTICS

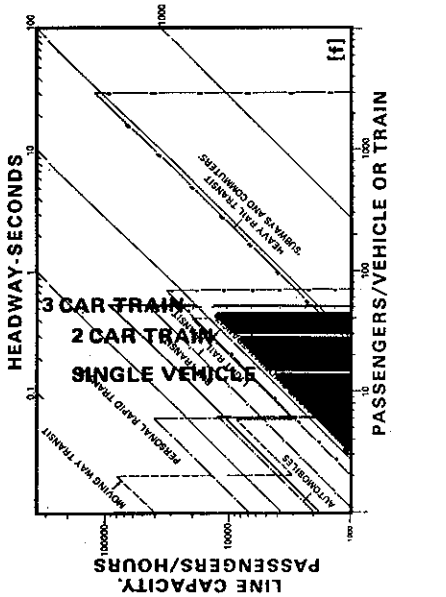
SYSTEM PERFORMANCE:

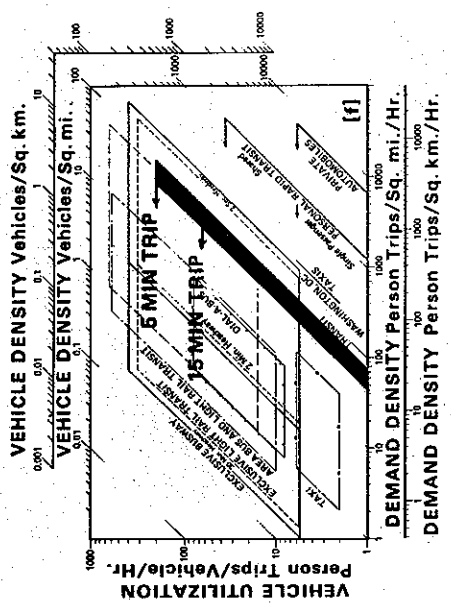
Max Theoretical One-Way Capacity	21,000 psgr/hr
Max Practical One-Way Capacity	13,000 psgr/hr
Min Theoretical Headway	12 sec
Min Practical Headway	15 sec
Availability	Scheduled
Type Service	Area collection/distribution
Type Network	Loop and feeder network
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicle or 2-3 vehicle trains

VEHICLE PERFORMANCE:

Cruise Velocity	34 or 55 mph (54 or 90 km/h)
Max Velocity	55 mph (90 km/h)
Max Grade	10%
Service Acceleration	4.1 ft/s^2 (1.25 m/s^2)
Service Deceleration	4.1 ft/s^2 (1.25 m/s^2)
Max Jerk	4.1 ft/s^3 (1.25 m/s^3)
Emergency Decel	Greater than 4.1 ft/s^2 (1.25 m/s^2)
Stopping Precision in Station	6 in (150 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & Snow	Heated tracks in case of ice and snow







Vehicle Design Capacity . . . . . 6 seated 9 standing
Vehicle Crush Capacity . . . . . 6 seated 18 standing
Energy Consumption, Accelerating and Decelerating Only
Empty Vehicle . . . . . 2.5 kwh/veh-mi (1.6 kwh/veh-km)
At Design Capacity . . . . . 3.0 kwh/veh-mi (1.9 kwh/veh-km)
Energy Consumption, Cruise Only
Empty Vehicle . . . . . 1.05 kwh/veh-mi (0.65 kwh/veh-km)
At Design Capacity . . . . 1.29 kwh/veh-mi (0.80 kwh/veh-km)

STATIONS:

Type . . . . . .Off-line (two parallel platforms), on line in smaller system
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Ticket machines and automatic barriers
Security . . . . . .Closed circuit TV at stations and voice circuit to central control
Boarding Capacity . . . . . 10,000 psgr/hr/platform
Deboarding Capacity . . . . . 10,000 psgr/hr/platform
Max Wait Time . . . . . 30 sec
Vehicle in Station Dwell Time . . . . . 15 sec
Average Station Spacing . . . . . 0.3 mi (0.5 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Vehicle shared by other passengers
Transfers . . . . . Transfers may be required
Stops . . . . . .Stops at each station, non-stop express service available
Accommodation . . . . . .Seated and standing
Comfort . . . . . Enclosed, heating, ventilation, air conditioning if required
Security . . . . . .Voice circuit to central control and dual emergency handle
Instruction . . . . . .Full visual display of vehicle destination and voice instructions from central control

RELIABILITY & SAFETY:

Fail Safe Features . . . . . All conditions which lead to danger to passengers cause emergency stopping; e.g., switch failure, headway control failure, service brake failure, control failure, etc. Basic philosophy is that a tram can stop safely in the event of the preceding tram having a "dead-wall" stop.
Fail Operational Features . . . . . .Data unavailable
Total System Mean Time Before Failure . . . . . .Data unavailable
System Restore Time After Failure . . . . . 0.75 hrs
Station Mean Time Before Failure . . . . . .Data unavailable
Station Restore Time After Failure . . . . . .Data unavailable
Vehicle Mean Time Before Failure . . . . . 2,000 hrs
Strategy For Removal of Failed Vehicle . . . . . .Clear track to next spur, tow vehicle using specialized tug
Strategy For Passenger Evacuation of Failed Vehicle . . . . . .Exit thru emergency doors, walk along track to next station
System Lifetime . . . . . 50 years
Vehicle Lifetime . . . . . 20 years

MAINTENANCE:

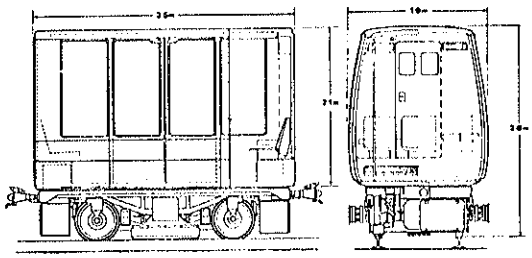
Inspection Frequency (One-way guideway assumed) . . . . . .
Guideway . . . . . 0.13 hrs every 1 days/0.6 mi (1 km)
Station . . . . . 0.25 hrs every 1 days/station
Vehicle . . . . . 0.33 hrs every 1 days
Periodic Maintenance . . . . . .
Guideway . . . . . .Data unavailable
Station . . . . . .Data unavailable
Vehicle . . . . . 4 hrs every 30 days
Adjustments Required . . . . . .Data unavailable
Other Maintenance . . . . Vehicle general overhaul every 500,000 km

CARGO CAPACITY:

Passenger Articles . . . . . .Hand baggage
Goods Movement . . . . . Provided at expense of passenger service

PERSONNEL REQUIREMENTS:

No. of Operators/Vehicle . . . . . None
No. of Attendants/Station . . . . . None
No. of Central Control Attendants . . . . . 3/8 hrs
No. of Maintenance Personnel
Engineering Staff
No. of Administrative Personnel } . . . . . Data unavailable



"EASAMS Copyright."
VEHICLE FRONT AND SIDE VIEWS

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 11.6 ft (3550 mm)
Overall Width . . . . . 6.2 ft (1900 mm)
Overall Height . . . . . 9.2 ft (2800 mm)
Empty Weight . . . . . 7,385 lbs (3350 kg)
Gross Weight . . . . . 9,039 lbs (4100 kg)
Passenger Space (Design Load) . . . . . 19.4 ft^2 (1.8 m^2) seated
47.4 ft^2 (4.4 m^2) standing
Doorway Width . . . . . 55.1 in (1400 mm)
Doorway Height . . . . . 76.8 in (1950 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . .Steel wheels on steel rails employing pneumatic suspension with hydraulic damping
Design Load . . . . . Data unavailable
Lateral Guidance . . . . . Flanged steel wheels on steel rails

PROPULSION & BRAKING:

Type & No. Motors . . . . . 1 series wound dc traction motor of 600 v
Motor Placement . . . . . Centrally placed below passenger compartment
Motor Rating . . . . . 94 HP, 70 kw at 4,500 rpm
Type Drive . . . . . Cardan shafts to right angle gear to axles
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 480 vac, 3ϕ
Power Collection . . . . . Spring loaded boom to three phase conductor rails
Type Service Brakes . . . . . .Air operated friction disc
Type Emergency Brakes . . . . . A spring loaded electromagnetic friction track brake
Emergency Brake Reaction Time . . . . . Data unavailable

SWITCHING:

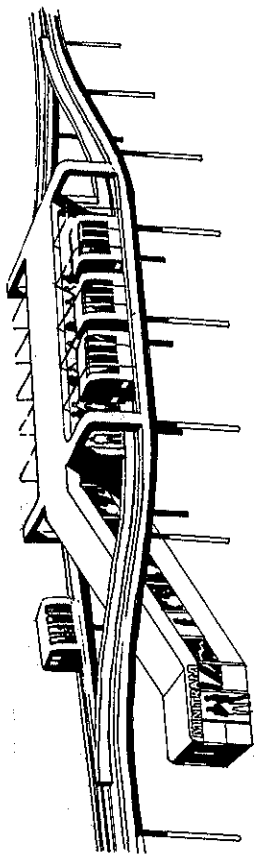
Type & Emplacement . . . . . Track switch with mechanical locking and electrical detection circuits
Switch Time (lock-to-lock) . . . . . 3 sec
Speed Thru Switch . . . . . 8.1 mph (13 km/h) max
Headway Thru Switch . . . . . 11 sec min

GUIDEWAY:

Type . . . . . .At-grade and below-grade type track, above-grade concrete guideway
Materials . . . . . At-grade and below-grade ballast, above-grade reinforced concrete
Running Surface Width . . . . . Gauge (1067 mm)
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 98 ft (30000 mm)
- Overall Cross Section Width . . . . . 7.8 ft (2375 mm)
- Overall Cross Section Height . . . . . 4.5 ft (1370 mm)
- Design Load . . . . . Data unavailable

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 98 ft (30000 mm)
- Overall Cross Section Width . . . . . 15.6 ft (4750 mm)
- Overall Cross Section Height . . . . . 4.5 ft (1370 mm)
- Design Load . . . . . Data unavailable

Guideway Passenger Emergency Egress . . . . . At-grade, over guideway walls (reinforced concrete)
Type Elevated Guideway Support Columns . . . . . .Precast concrete columns



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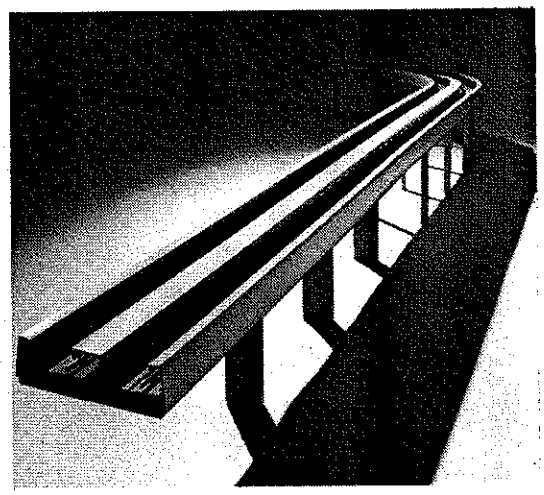
STATION DRAWING



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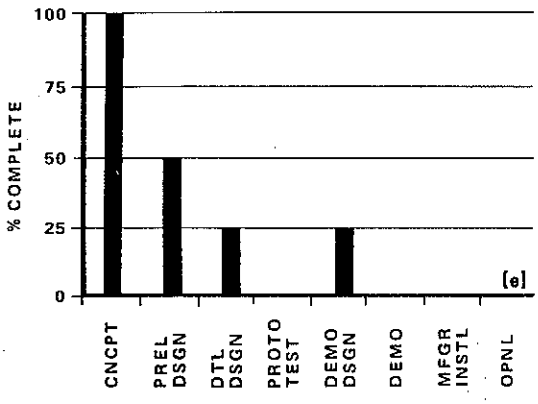
GUIDEWAY MODEL



DEVELOPMENT STATUS

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PROPOSED INSTALLATION IN SHEFFIELD

CONTROL:

The control system performs two duties:

a) prevents collisions

b) controls speed of vehicles to maintain headways.

The central control area communicates with each vehicle on the track in quick succession via an inductive loop communication system laid in the track bed. If control commands are not received and returned, or are not compatible, the vehicle automatically brakes to rest. Dual computers ensure safety.

The headway is controlled using a synchroneous control concept with the overseeing safety logic using a moving block control.

STATIONS:

Stations either can be on-line or 'D loop' if higher capacities are needed.

Passengers enter platform area by automatic barriers. Passengers enter vehicles by platform doors, which will only open if vehicle is in position and stationary.

Stations are linked to central control by closed circuit television and two way voice circuit.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Work has been carried out by a group fo GEC companies led by EASAMS Ltd. A feasibility and project definition study was carried out for the Department of the Environment and a report presented in August, 1974. The Minitram project is continuing with company funding and it is envisaged that a test track will be completed by the end of 1976. A public demonstration system is proposed in the city of Sheffield, England, to be operating by 1981.

INSTALLATIONS & CONTRACTS:

None

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 7.8 ft (2375 mm)
Single Lane Guideway Envelope Height . . . . . 11.8 ft (3600 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 10%
Min Vertical Turn Radius . . . . . 591 ft (180 m) at 34 mph (54 km/h)
Min Horizontal Turn Radius . . . . . 39 ft (12 m) at 9 mph (13.9 km/h)
Construction Process . . . . . Precast units placed on foundations
Staging Capability . . . . . System can be expanded in stages without major changes in controls.

LIMITATIONS:

Track heating may be required for cold climates.

Headway is limited by stations.

Allowed speeds, accelerations, jerks all limited by passenger comfort.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 4.49 ft (1370 mm), H_2 – 11.64 ft (3550 mm)
W_1 – 7.79 ft (2375 mm), W_2 – 6.23 ft (1900 mm)
P_1 – 8.69 ft (2650 mm), P_2 – 13.12 ft (4000 mm)
Noise . . . . . 55 dbA inside vehicle
65 - 70 dbA at 24.6 ft (7.5 m) to side

H-BAHN

CLASSIFICATION: Light Guideway Transit*

OTHER NAMES: None

DEVELOPER: Siemens Aktiengesellschaft
Bereich Energietechnik Bahnen E41
H-Bahn-Projektgruppe
D-8520 Erlangen
Werner-von-Siemens-Strasse 50
West Germany

Düwag Waggonfabrik Uerdingen AG
Werk Düsseldorf, Düsseldorf
Königsbergerstr. 100
West Germany

LICENSEES: None

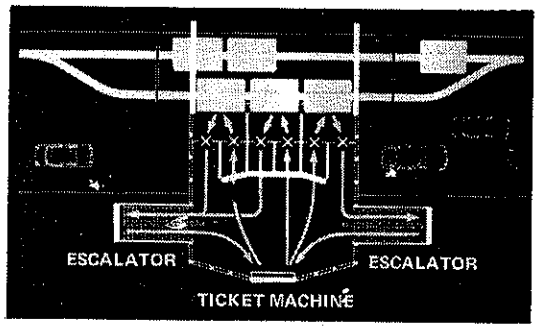
PATENTS: Information unavailable

DATA REFERENCE CODE: [a: except as noted]

SYSTEM DESCRIPTION:

H-Bahn is a light guideway transit system for transporting passengers in vehicles with 6 seats and standing room for 6, or up to 28 seats and standing room for 35. Vehicles are suspended underneath an overhead guideway. The passengers book a vehicle at an automatic ticket machine by pressing a destination button on a schematic route map. Vehicles may be shared by passengers with similar destinations and are routed by station computers. For high demand periods 2 vehicles may be linked together. The system, including stations, is fully automatic.

PHOTOMONTAGE FROM
1/5 SCALE MODEL



STATION LAYOUT

OPERATIONAL CHARACTERISTICS

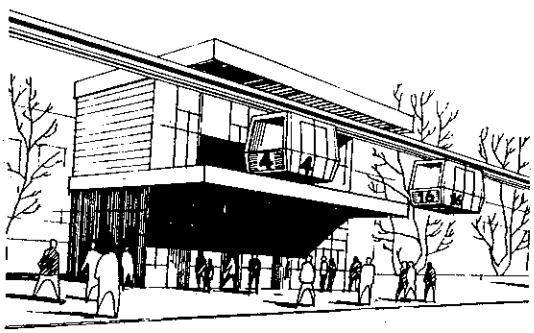
SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	7,200 or 14,400 psgr/hr[1]
Max Practical One-Way Capacity	3,600 or 7,200 psgr/hr[1]
Min Theoretical Headway	8 sec
Avg Headway	16 sec
Availability	As required: scheduled, on-demand or continuous operation
Type Service	Linear or area collection and distribution
Type Network	Linear, loop, or grid network
Type of Vehicle Routing	Fixed and/or variable
Traveling Unit	Single vehicles or vehicle pairs

VEHICLE PERFORMANCE:

Cruise Velocity	22 mph (36 km/h)
Max Velocity	22 mph (36 km/h)
Max Grade	15%
Service Acceleration	4.1 ft/s^2 (1.25 m/s^2)
Service Deceleration	4.1 ft/s^2 (1.25 m/s^2)
Max Jerk	5.6 ft/s^3 (1.7 m/s^3)
Emergency Decel	8.2 ft/s^2 (2.5 m/s^2)
Stopping Precision in Station	±3.93 in (±100 mm)
Degradation if Guideway is Wet	Same as clear (covered guideway)
Degradation for Ice & Snow	Same as clear (covered guideway)
Vehicle Design Capacity	As seen under "Physical Description" a variety of vehicle sizes are available:

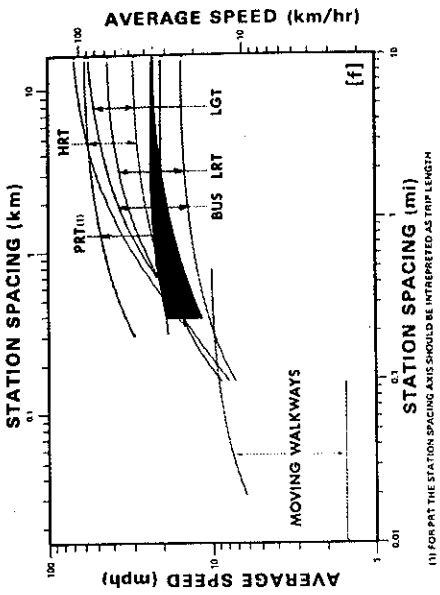
PHOTOMONTAGE FROM
1/5 SCALE MODEL

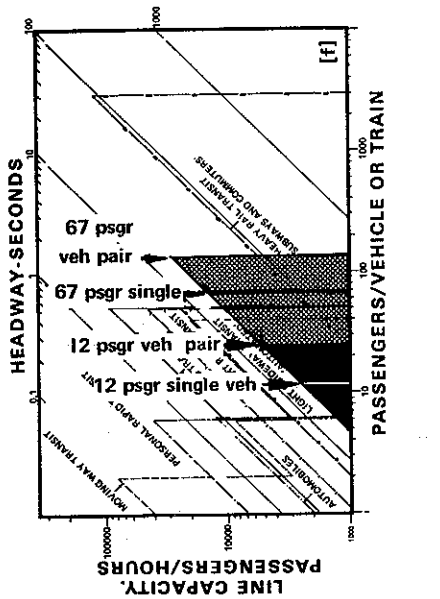


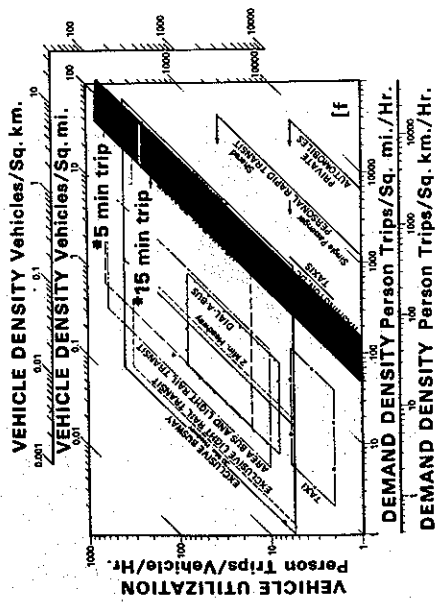
ARTIST VIEW OF STATION

PUBLISHER'S NOTE:
The H-Bahn system offers on-demand service, but the vehicles may be shared and 2 vehicle trains are possible. H-Bahn is therefore classified as LGT. Should exclusive non-stop service be offered for a single passenger it would be classified as PRT.

[1] Based upon 16 psgr vehicle in single vehicle or vehicle pairs operation







*Vehicle Utilization for 67-psgr Vehicle

Vehicle Type No.	1	1.11	1.12	1.21	1.22	1.23
Seated:	8	16	14	20	20	28
Standing:	8	28	28	47	42	35
Vehicle Type No.	2	2.11	2.12	2.21	2.22	2.23
Seated:	6	12	12	14	18	26
Standing:	6	22	20	37	30	20

STATIONS:

Type . . . . . Off-line and/or on-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic ticket machine and station computer
Security . . . . . Closed circuit TV
Boarding Capacity . . . . . 1,000 - 1,300 psgr/hr/berth
Deboarding Capacity . . . . . 1,000 - 1,300 psgr/hr/berth
Max Wait Time . . . . . 1 - 3 min
Vehicle in Station Dwell Time . . . . . 30 sec
Average Station Spacing . . . . . 0.31 mi (0.5 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles
Transfers . . . . . Not necessary
Stops . . . . . Limited stops for other passengers
Accommodation . . . . . Seated and standing
Comfort . . . . . Heating and ventilation
Security . . . . . Emergency button and intercom
Instruction . . . . . Ticket machines with route maps and information boards in the stations

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Vehicle headway is monitored by vehicle detection devices. If the distance falls below the min of 262.4 ft (80 m) the emergency braking system, consisting of two spring brakes, is actuated.
If one line becomes blocked, the central computer selects an alternate route.

Fail Operational Features . . . . . If a breakdown of a station computer occurs, the vehicles will not stop at this station.
If a breakdown of the central computer occurs, the system will be automatically switched to linear network and operation will continue.

Total System Mean Time Before Failure . . . . . Design goal is that system will operate for one year without occurance of a total system failure or equipment replacement.

System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Data unavailable

Strategy for Removal of Failed Vehicle . . . . . Towing away of vehicle by emergency vehicle
Guideway Lifetime . . . . . Approx 70 years
Central Computer & Station Computers Lifetime . . . . 20 - 25 years
Station Lifetime . . . . . 70 years
Vehicle Lifetime . . . . . 20 - 25 years

MAINTENANCE:

The central computer determines the maintenance and cleaning of vehicles dependent upon running time. Special vehicles are planned for cleaning the inside of the guideway.

CARGO CAPABILITY:

Passenger Articles . . . . . Provisions for luggage, wheelchairs, baby carriages
Goods Movement . . . . . Specially design freight vehicles

PERSONNEL REQUIREMENTS:

Attendants are required at a central control station as well as maintenance personnel.

PHYSICAL DESCRIPTION

VEHICLE:

12 Vehicle Types . . . . . Nos. 1, 1.11, 1.12, 1.21, 1.22, 1.23, 2, 2.11, 2.12, 2.21, 2.22, 2.23

Overall Length . . . . . Nos. 1, 2, – 11.32 ft (3450 mm); Nos. 1.11, 1.12, 2.11, 2.12, – 23.47 ft (7155 mm); Nos. 1.21, 1.22, 1.23, 2.21, 2.22, 2.23 – 35.63 (10860 mm)

Overall Width . . . . . .Nos. 1, 1.11, 1.12, 1.21 1.22, 1.23 – 7.55 ft (2300 mm); Nos. 2, 2.11, 2.12, 2.21, 2.22, 2.23 – 6.17 ft (1880 mm)

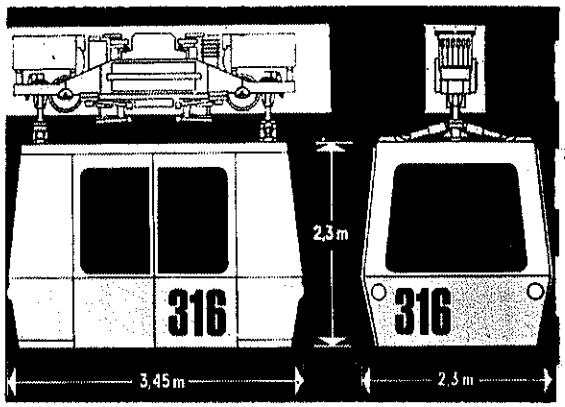
Overall Height . . . . . For all vehicle types – 7.55 ft (2300 mm)

Gross Weight . . . . . Data unavailable

Passenger Space (Design Load) . . . . . .

4.48 ft² (0.45 m²) seated
3.44 ft² (0.32 m²) standing
} For type 1 Data unavailable for other types

Doorway Width . . . . . 5.25 ft (1600 mm)
Doorway Height . . . . . 7.55 ft (2300 mm)
Step Height . . . . . Level
} for all cabin types



VEHICLE

SUSPENSION:

Type . . . . . .Two steel wheels, plastic coated

Design Load . . . . . Data unavailable

Lateral Guidance . . . . . .By two steel wheels and guiding pullies in upper part of running gear; electromagnetically, sideways with linear synchronous electric motors

PROPULSION & BRAKING:

Type & No. Motors . . . . . Two linear synchronous electric motors

Motor Placement . . . . . .Active elements aboard vehicle

Motor Rating . . . . . 16.8 HP, 12.5 kw

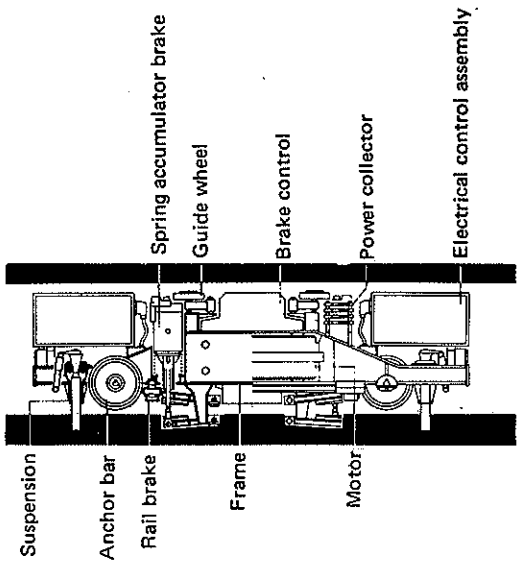
Type Power . . . . . 380 Vac, 50 Hz

Power Collection . . . . . Glides, conductor rails along guideway inside sidewalls

Type Service Brakes . . . . . .Dynamic through motors

Type Emergency Brakes . . . . .Dynamic electric plus spring actuated mechanical

Emergency Brake Reaction Time . . . . . .Approx 1 sec



MOTOR BOGEY

SWITCHING:

Type & Emplacement . . . . On-board, electromagnetic through one of the synchronous linear electric motors

Switch Time (lock-to-lock) . . . . . 8 sec max

Speed Thru Switch . . . . . 22 mph (36 km/h) max

Headway Thru Switch . . . . . 8 sec min

GUIDEWAY:

Type . . . . . Overhead inverted U box-beam

Materials . . . . . .Steel

Running Surface Width . . . . . Not applicable

Single Lane Elevated Guideway:

Max Elevated Span . . . . . 295 ft (90000 mm)

Overall Cross Section Width . . . . . 2.46 ft (750 mm)

Overall Cross Section Height . . . . . 3.12 ft (950 mm)

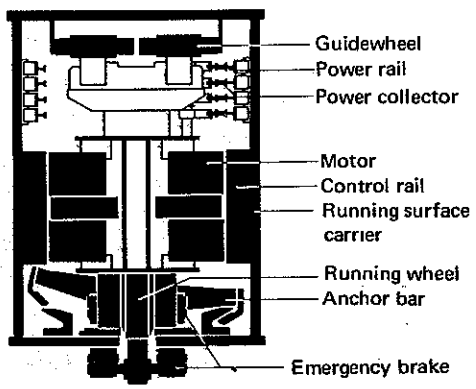
Design Load . . . . . Data unavailable

Guideway Passenger Emergency Egress . . . . . .

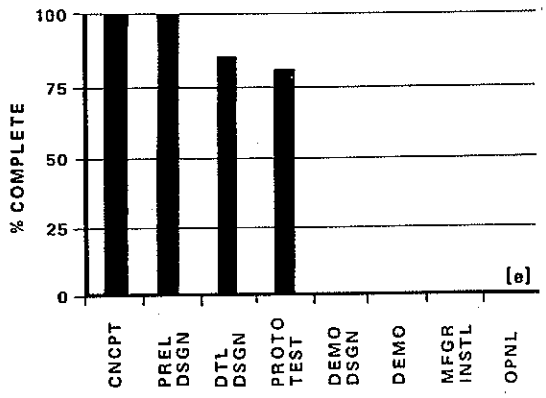
Several emergency systems are under study, such as:

- picking up of passengers with emergency vehicle
- lowering the vehicle to ground level
- exit of passengers through an emergency tube which is built into the floor of the cabin

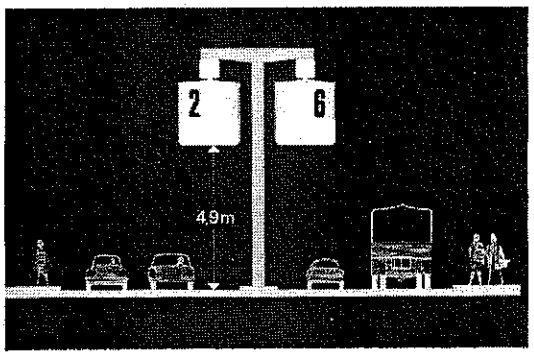
Type Elevated Guideway Support Columns . . Inverted L- or T-columns



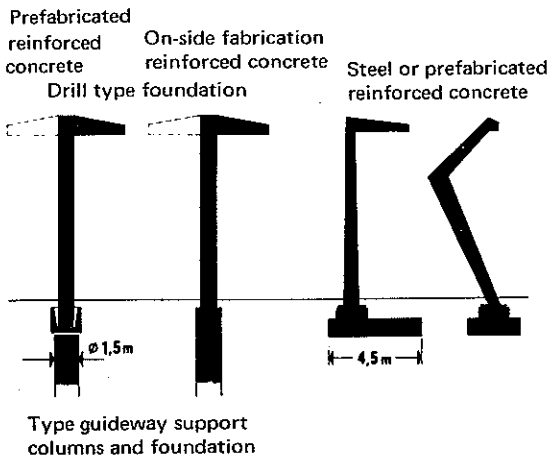
SECTION VIEW OF BOGEY AND GUIDEWAY ELEMENTS



DEVELOPMENT STATUS



TYPICAL OVERHEAD INSTALLATION



Type guideway support columns and foundation

TYPE GUIDEWAY SUPPORT COLUMNS AND FOUNDATION

CONTROL:

In a city network the H-Bahn cabins are controlled by a traffic computer with decentralized sub-systems. The computer not only controls the circulation of cabins and matches their number to the traffic requirements, but it also steers them to their destinations with a minimum of intermediate stops and insures safe merging into trunk sections.

Stationary sensors report the cabin positions to the control computer and at regular intervals the passenger is informed of his position by a communication system.

The constancy of the headways of all cabins on the track network is reliably insured by the synchronous traction system. The subordinate safety system of the cabins, the headway of which always exceeds their stopping distance, is composed of electronic contacts in conjunction with simple, intrinsically safe logic circuits.

STATIONS:

Passenger access to vehicles is computer controlled. Stations are equipped with a ticket machine, station computer, information board (display of arrival time), and waiting area. Dimensions are dependent upon site-specific requirements.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Summer 1972 . . . . . .Development began
1973 . . . . . Tests of components and LIM
1974/75 . . . . . Initial trials of the overhead cabin system (scale 1:1)
1975/76 . . . . . .Test trials on a large scale continuous testing circuit with 3 stations planned [Test track length: 0.93 - 1.24 mi (1.5 - 2.0 km)]

INSTALLATIONS & CONTRACTS:

Experimental switch installation in Düsseldorf [1 switch, 492 ft (150 m)] started in fall 1974.

COSTS:

Information unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . .Approx 12.7 ft (3860 mm)
Single Lane Guideway Envelope Height . . . Approx 9.0 ft (2740 mm)
Single Lane Guideway Structural Weight
Double Lane Guideway Structural Weight } . . . . . Data unavailable
Max Grade 15%
Min Vertical Turn Radius . . . 328 ft (100 m) at 22.4 mph (36 km/h)
Min Horizontal Turn Radius . . . . . 131 ft (40 m)
Contruction Process . . . . . .Prefabricated guideway sections
Staging Capability . . . .Sections may be put in operation while others are under construction.

LIMITATIONS: [e]

Relative low speed 22.4 mph (36 km/h) and intermediate stops may yield lower average speeds.

ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 3.12 ft (950 mm), H_2 – 11.65 ft (3550 mm)
W_1 – 2.46 ft (750 mm), W_2 – 7.9 ft (2300 mm)
P_1 – 3.9 ft (1190 mm), P_2 – 11.7 ft (3570 mm)
Noise . . . . . .Data unavailable

INSTA - GLIDE

CLASSIFICATION: Light Guideway Transit

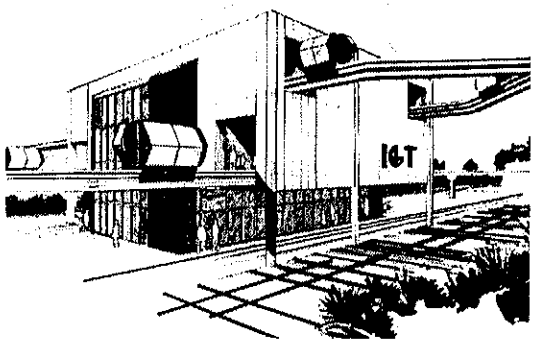
OTHER NAMES: None

DEVELOPER: Linear Air Motors, Inc.
5754 Kennebunk
Rochester, Michigan 48063, U.S.A.

LICENSEES: None

PATENTS: U.S. Patent No. 3,722,427 for a Pneumatic Transit System and patent pending on Helical Motor Drive

DATA REFERENCE CODE: [a 51: except as noted]



TYPICAL TRANSFER STATION

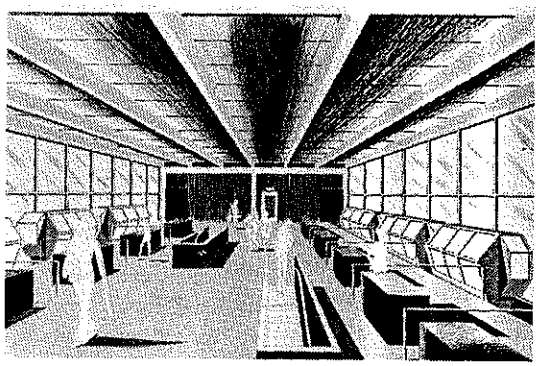
SYSTEM DESCRIPTION:

Insta-Glide is a light Guideway Transit system for transporting passengers and goods in small vehicles of up to 16 seats each over exclusive guideways. Proposed guideways are either twin type or single supports with turnaround loops at each end, a single guideway to form a closed loop, or a combination of both.

System network is provided by either a number of twin guideways arranged in parallel with similar guideways arranged at right angles, thereby providing service in all directions or by switching off a loop for "suburban" stations or connections to other loops.

Stations are located at guideway intersections (if required) and other points as necessary along the route. In this manner, vehicles always remain on the same guideway, passengers transferring at intersection stations.

The mode of operation for a typical operating loop is as follows: An express train is formed at station "A" with passengers destined for station "B" taking seats in the lead cars. Passengers for subterminals 3, 2 & 1 are programmed in the preceeding cars. As the train travels along the guideway and approaches sub-terminal 1, trailing cars for that station slow down and stop at the pre-determined gate while the remaining vehicles continue their express journey. This procedure is repeated at sub-terminals 2 & 3 with the lead vehicles continuing their express journey to station "B". Where vehicles are programmed to "switch off" to another loop, the selected vehicles are slowed at a monitoring point ahead of each switch. The control system scans the switching area. Upon receipt of a "system clear" signal, the air lock closes and the guideway switches to the alternate position.



TYPICAL STATION INTERIOR

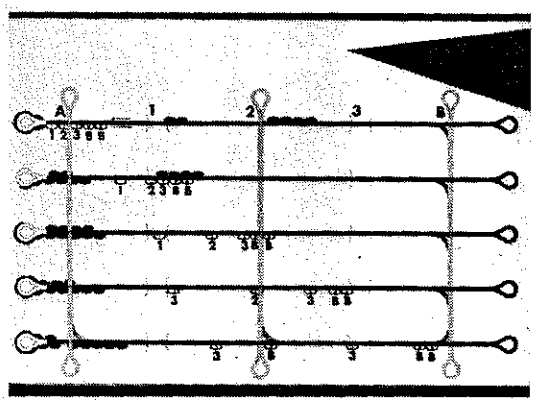
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

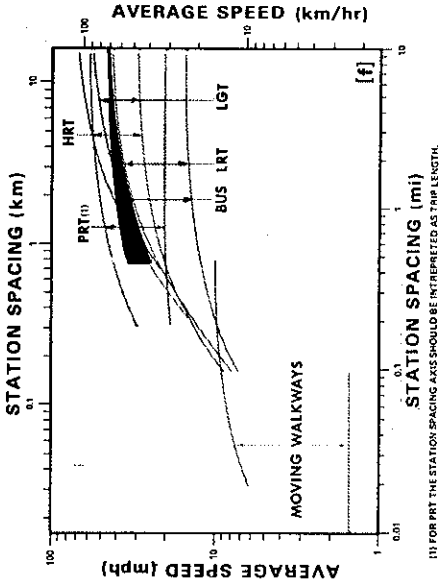
Max Theoretical One-Way Capacity	13,000 psgr/hr
Max Practical One-Way Capacity	Data unavailable
Min Theoretical Headway	Data unavailable
Min Practical Headway	7.2 sec
Availability	Scheduled or by demand [e]
Type Service	Area collection and distribution
Type Network	Area grid of two-way loops
Type of Vehicle Routing	Fixed
Traveling Unit	Single vehicles in a disconnected train

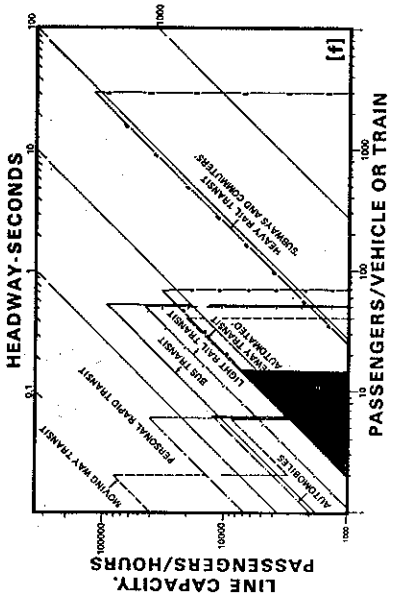
PUBLISHER'S NOTE:

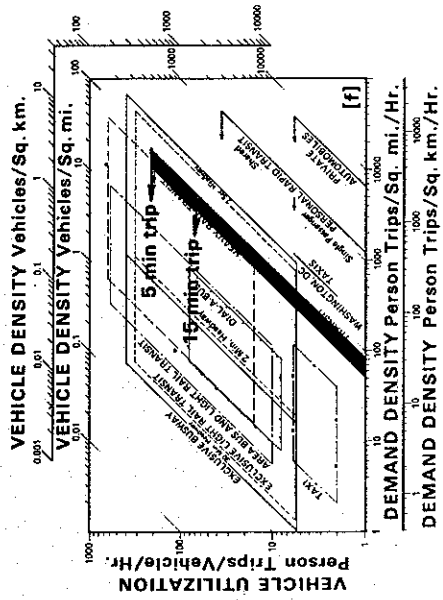
The system has been classified as Light Guideway Transit because it does not offer exclusive service; however, small 2-seated vehicles have also been proposed. If such a system offered exclusive service, it would then be classified as PRT.



TYPICAL NETWORK







VEHICLE PERFORMANCE:

Cruise Velocity	45 mph (72.5 km/h)
Max Velocity	50 mph (80.5 km/h)
Max Grade	15%
Service Acceleration	5.0 ft/s^2 (1.5 m/s^2)
Service Deceleration	6.0 ft/s^2 (1.8 m/s^2)
Max Jerk	3.0 ft/s^3 (0.91 m/s^3)
Emergency Decel	16 ft/s^2 (4.5 m/s^2)
Stopping Precision in Station	2.0 in (50.8 mm)
Degradation if Guideway is Wet	Data unavailable
Degradation for Ice & Snow	Data unavailable
Vehicle Design Capacity	16 seated 0 standing
Vehicle Crush Capacity	16 seated 10 standing (Smaller 2-seated vehicles have been proposed as PRT)
Energy Consumption	1.0 kwh/veh-mi (0.62 kwh/veh-km)

STATIONS:

Type	Off-line loading at high density stations or on-line sequentially loaded vehicles
Type Boarding	Level
Ticket or Fare Collection	Automatic machines
Security	Closed circuit TV and roaming station attendants
Boarding Capacity	13,000 psgr/hr/direction per terminal station
Boarding Capacity	3,250 psgr/hr/direction per intermediate station
Deboarding Capacity	13,000 psgr/hr/direction per terminal station
Deboarding Capacity	3,250 psgr/hr/direction per intermediate station
Max Wait Time	2 min
Vehicle in Station Dwell Time	25 sec
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles. Vehicles are divided into 2 compartments with 8 seats each.
Transfers	Required for destination not on loop
Stops	Non-stop per loop
Accommodation	Seated and standing
Comfort	Heated and air conditioned vehicles
Security	Voice responsive alarm, push button alarms, and roaming station attendants
Instruction	Signs, maps, and active graphics

RELIABILITY & SAFETY:

Fail Safe Features	Air cushion control between vehicles, vital mode relay sub-system, helical drive return to zero pitch and regenerative braking through vehicle battery
Fail Operational Features	Air cushion control between vehicles
Total System Mean Time Before Failure	1,000 hrs
System Restore Time After Failure	2 hrs
Station Mean Time Before Failure	1,500 hrs
Station Restore Time After Failure	2 hrs
Vehicle Mean Time Before Failure	3,000 hrs
Strategy For Removal of Failed Vehicle	Data unavailable
Strategy For Passenger Evacuation of Failed Vehicle	Data unavailable
System Lifetime	15 years
Vehicle Lifetime	Data unavailable

MAINTENANCE: [b]

The maintenance facility is an enclosed building located inside one end of the loop at track level, with a switched section of guideway passing through. The facility will be equipped with hoists, work benches, "A" frames, compressed air, etc. Two recovery service vehicles are provided. These gasoline driven vehicles will tow or push faulty cars along the guideway to the maintenance area.

CARGO CAPABILITY: [b]

Passenger Articles	Small packages and hand luggage
Goods Movement	Vehicle load capacity of up to 4,000 lbs

PERSONNEL REQUIREMENTS:

Attendants at central control facility & maintenance personnel

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 14.0 ft (4267 mm)
Overall Width . . . . . 6.0 ft (1829 mm)
Overall Height . . . . . 8.0 ft (2438 mm)
Empty Weight . . . . . 2,500 lbs (1134 kg)
Gross Weight . . . . . 6,700 lbs (3039 kg)
Passenger Space (Design Load) . . . . . 30.0 - 40.0 ft^2 (2.8 - 3.7 m^2)
Doorway Width . . . . . 42.0 in (1067 mm)
Doorway Height . . . . . 78.0 in (1981 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . Vehicle is supported on 4 rubber tires with stabilization via lateral rubber tires
Design Load . . . . . 4,200 lbs (1905 kg)
Lateral Guidance . . . . . Constrained by propulsion unit which is enclosed in a tube

PROPULSION & BRAKING:

Type & No. Motors . . . . . Constant speed ac electric motor
Motor Placement . . . . . On-board vehicle, rides inside a tube
Motor Rating . . . . . 40 HP, 120 ft-lbs (16.6 kg-m)
Type Drive . . . . . Variable pitch helical drive
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 220 - 440 vac 3 phase
Power Collection . . . . . Rails on guideway, collector shoes on motor
Type Service Brakes . . . . . Pneumatic piston inside guideway tube
Type Emergency Brakes . . . . Pneumatic piston inside guideway tube
Emergency Brake Reaction Time . . . . . Data unavailable

SWITCHING: [a 11]

Type & Emplacement . . . . . Guideway tube section physically moved
Switch Time (lock-to-lock) . . . . . 1 sec
Speed Thru Switch . . . . . 25 mph (40 km/h) max
Headway Thru Switch . . . . . 5 sec min

GUIDEWAY:

Type . . . . . T section with imbedded guideway tube
Materials . . . . . Prestressed concrete and fiberglass reinforced plastic
Running Surface Width . . . . . 3.4 ft (1036 mm)
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 100 ft (30480 mm)
- Overall Cross Section Width . . . . . 3.4 ft (1036 mm)
- Overall Cross Section Height . . . . . 4.17 ft (1271 mm)
- Design Load . . . . . Data unavailable

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 100 ft (30480 mm)
- Overall Cross Section Width . . . . . 10.4 ft (3169.9 mm)
- Overall Cross Section Height . . . . . 4.17 ft (1271 mm)
- Design Load . . . . . Data unavailable

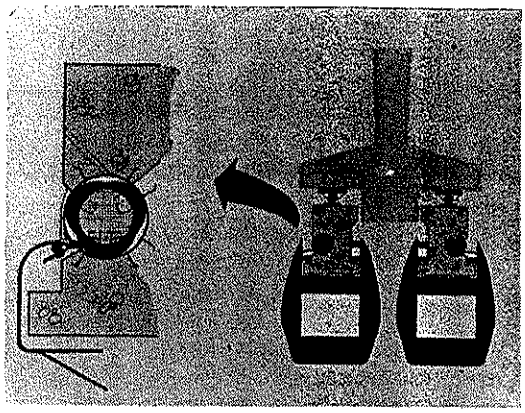
Guideway Passenger Emergency Egress . . . . . Data unavailable
Type Elevated Guideway Support Columns . . . . . Prestressed concrete

CONTROL: [e]

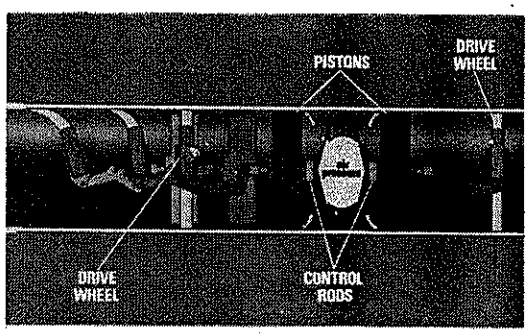
Headway is controlled asynchronously via pneumatic spacing of vehicles, which is provided by an air-lock created between successive vehicle propulsion units inside the guideway tube. The air-lock is created by pistons within each propulsion unit. Station computers dispatch vehicles which are free to run at max speed until the pressure inside the tube builds up a retarding force, which acts on the piston changing the pitch of the Helical Motor Drive, thereby slowing it down. Headway control therefore is an integral part of the propulsion system design.

STATIONS: [b]

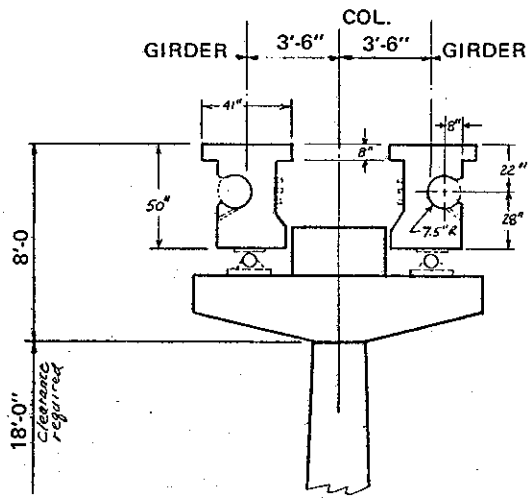
Stations are designed essentially as enclosed platforms with dimensions according to site-specific requirements. Intermediate stations would be island platforms. Stations at crossings would be at two levels with each level having switching facilities for off-line loading and unloading. Terminal stations would have both island and side platforms.



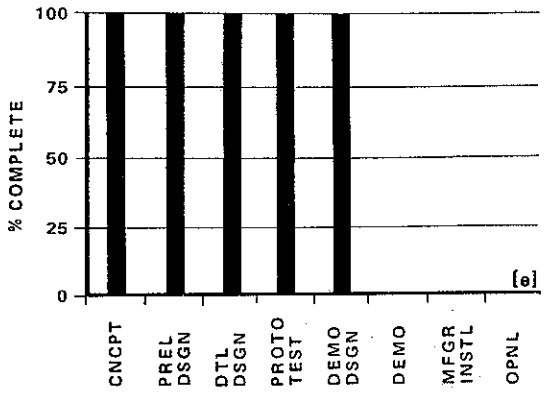
VEHICLE/GUIDEWAY INTERFACE



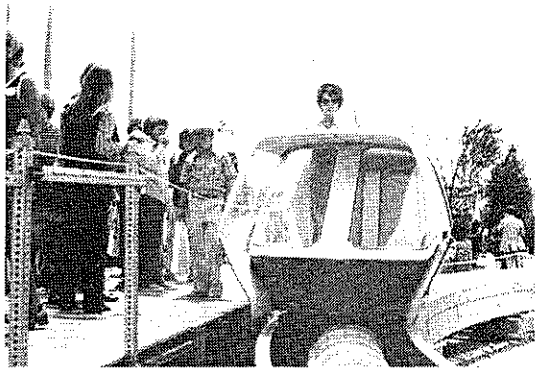
HELICAL MOTOR DRIVE PROPULSION AND CONTROL UNIT



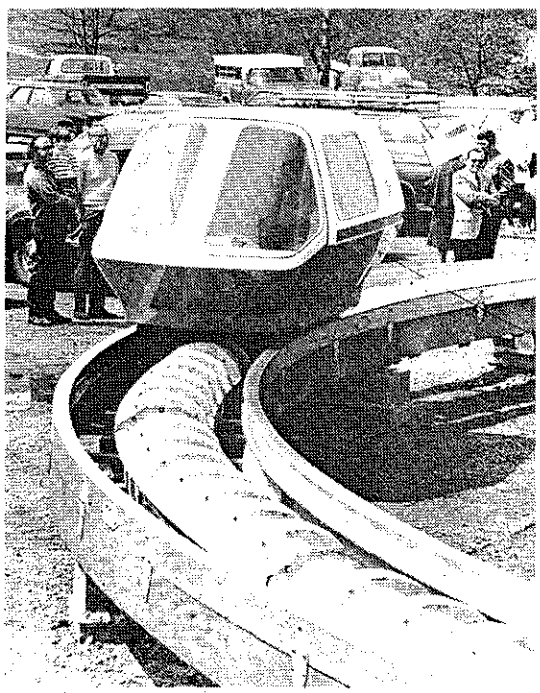
GUIDEWAY CROSS SECTION



DEVELOPMENT STATUS



TRANSPO '72 DEMONSTRATION



TEST TRACK IN PONTIAC, MICH.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The Insta-Glide concept was begun by Linear Air Motors, Inc., in 1970. An initial patent was issued for a Pneumatic Transit System which incorporated the basic principle of pneumatic control and spacing which the present concept uses. A number of vehicle suspension and guideway configuration designs have been made. A circular track with one vehicle was demonstrated at Transpo '72 through private funds.

INSTALLATIONS & CONTRACTS: [b]

Test Facility at Pontiac, Michigan, of 220 ft (67 m) circumference and 2 vehicles was built in 1972 and presently is in operation.

Letter of intent to buy a 3.5 mile loop system, from San Bernardino, Calif., subject to availability of federal funding. Also proposals current in 3 other cities.

COSTS: [b]

Capital . . . . . Approx $2.5 million/mile, 2-way guideway
$20,000/vehicle and drive unit
Operational . . . . . 2 cents/veh-mi for electrical power only
Maintenance . . . . . 0.75 cents/veh-mi

INSTALLATION OR RETROFIT CAPABILITY:

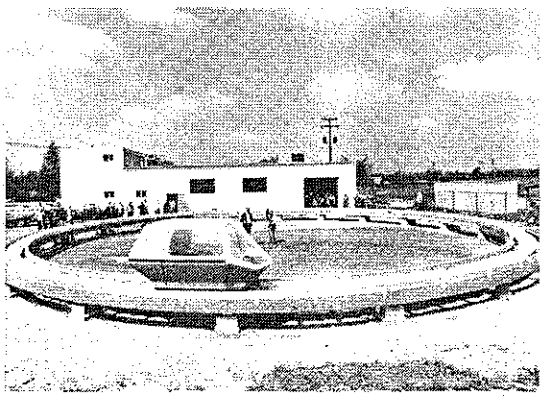
Single Lane Guideway Envelope Width . . . . . 6.0 ft (1828.8 mm)
Single Lane Guideway Envelope Height . . . . . 11.5 ft (3505.2 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 15%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . 25.0 ft (7.62 m) at reduced speed
Construction Process . . . . . Prefabricated guideway section
Staging Capability . . . . .A complete guideway loop must be installed before operated. Additional stations might be added to a loop at a later date.

LIMITATIONS: [e]

System which does not switch requires transfers if destination not on loop. A practical limit (probably 3 to 5) exists for intermediate stations to be located between the end terminals if switching is not used.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual, Single Lane Elevated Guideway . . . . . .[f]
H_1 – 4.17 ft (1271 mm), H_2 – 12.17 ft (30710 mm)
W_1 – 3.4 ft (1036 mm), W_2 – 6.0 ft (1829 mm)
P_1 – 5.5 ft (1676 mm), P_2 – 12.0 ft (3658 mm)
Noise . . . . . 30 dbA inside vehicle
45 dbA at 10 ft (3.05 m) from guideway [b 31]



TEST TRACK IN PONTIAC, MICH.

KCV (Kawasaki Computer-Controlled Vehicles)

CLASSIFICATION: Light Guideway Transit

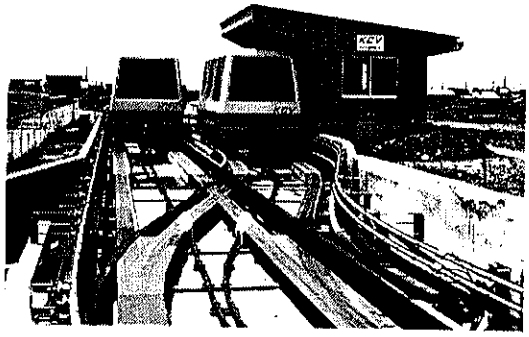
OTHER NAMES: None

DEVELOPER: Kawasaki Heavy Industries Ltd.
Rolling Stock Division
6, 1-chome, Wadayama-Dori
Hyogoku Kobe, Japan

LICENSEES: None

PATENTS: Japan patent No. 1025699, switch for guideway vehicle

DATA REFERENCE CODE: [a: except as noted]

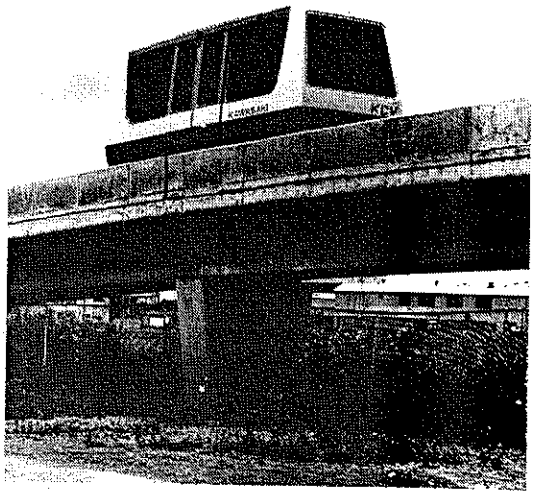


PROTOTYPE VEHICLES AND STATION

SYSTEM DESCRIPTION:

KCV is a Light Guideway Transit system for transporting both people and freight in small rubber tired vehicles over exclusive guideways under totally automatic control. Service is scheduled and on-demand as line-haul or around loops. Single uncoupled trains of 6 vehicles and specially designed freight vehicles are utilized.

In the event of automatic control system failure, manual control of the vehicle is provided.



PROTOTYPE VEHICLE ON CONCRETE GUIDEWAY

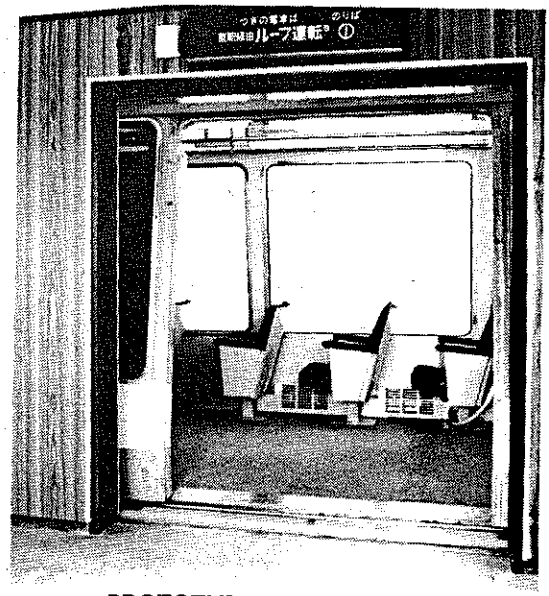
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

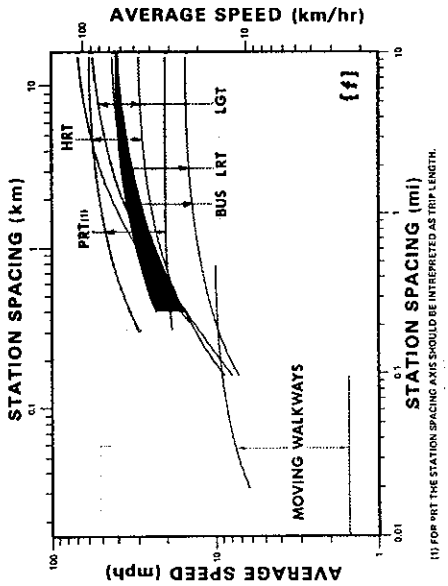
Max Theoretical One-Way Capacity	21,600 psgr/hr
Max Practical One-Way Capacity	18,000 psgr/hr
Min Theoretical Headway	75 sec
Min Practical Headway	90 sec
Availability	Scheduled or on-demand
Type Service	Line-haul or limited area collection and distribution [e]
Type Network	Linear and loops
Type of Vehicle Routing	Fixed
Traveling Unit	Single vehicles and up to 6 vehicle trains

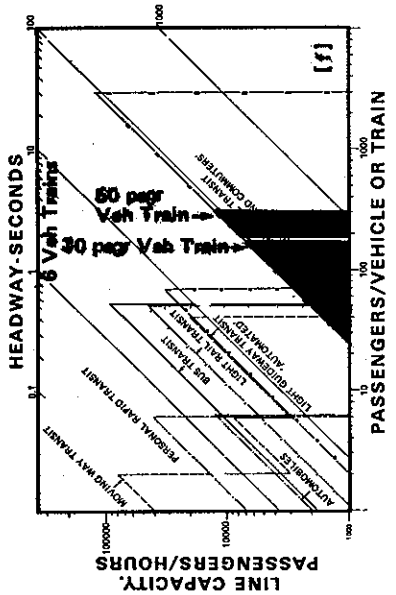
VEHICLE PERFORMANCE:

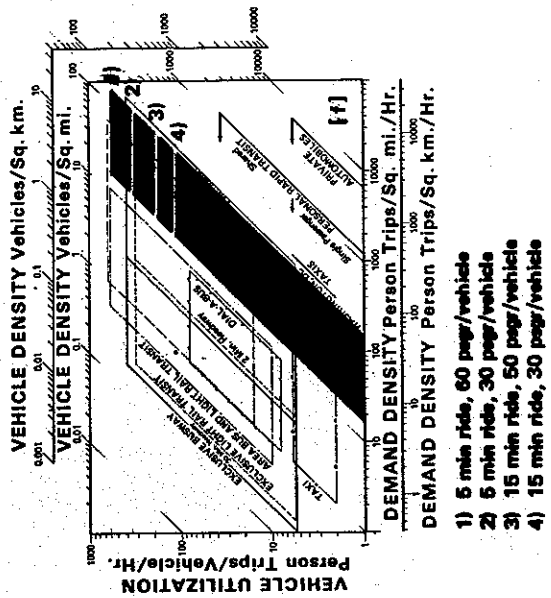
Cruise Velocity	40 mph (65 km/h)
Max Velocity	47 mph (75 km/h)
Max Grade	10%
Service Acceleration	3.84 ft/s^2 (1.17 m/s^2)
Service Deceleration	2.72 ft/s^2 (0.83 m/s^2)



PROTOTYPE VEHICLE AND STATION INTERIOR







Max Jerk	3.28 ft/s^3 (1.0 m/s^3)
Emergency Decel	5.02 ft/s^2 (1.53 m/s^2)
Stopping Precision in Station	±5.9 in (±150 mm)
Degradation if Guideway is Wet	None
Degradation for Ice & Snow	Information unavailable
Vehicle Design Capacity	16 - 24 seated 14 - 26 standing
Vehicle Crush Capacity	16 - 24 seated 29 - 51 standing
Energy Consumption	Data unavailable

STATIONS:

Type	On-line and off-line if required
Type Boarding Ticket or Fare Collection Security Boarding Capacity Deboarding Capacity Max Wait Time	Variable
Vehicle in Station Dwell Time	25 sec
Average Station Spacing	0.3 mi (0.5 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles.
Transfers	As required
Stops	Vehicles stop for other passengers.
Accommodation	Seated and standing
Comfort	Enclosed, air conditioned
Security	Closed circuit TV in stations
Instruction	Signs and active graphics above station doors

RELIABILITY & SAFETY:

Fail Safe Features Fail Operational Features	Automatic Train Operation (ATO) with background of Automatic Train Control (ATC), dual-redundant systems for essential parts, under test at time of printing
Total System Mean Time Before Failure System Restore Time After Failure Station Mean Time Before Failure Station Restore Time After Failure Vehicle Mean Time Before Failure Strategy For Removal of Failed Vehicle Strategy For Passenger Evacuation of Failed Vehicle	Data unavailable under test at time of printing
System Lifetime	Data unavailable
Vehicle Lifetime	10 years

MAINTENANCE:

Maintenance area provided. Vehicle checkout and certain maintenance is automated.

CARGO CAPABILITY:

Passenger Articles	Small articles, luggage and wheelchairs
Goods Movement	Special freight vehicles

PERSONNEL REQUIREMENTS:

Typical System of 80 vehicles, 18 stations and 8.4 mi (13.5 km) of one-way guideway

No. of Operators/Vehicle	None
No. of Attendants/Station	0.7
No. of Administrative Personnel	6
No. of Central Control Attendants	3/6 hrs
No. of Maintenance Personnel	4

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 20.83 - 29.86 ft (6350 - 9100 mm)
Overall Width . . . . . 7.71 ft (2350 mm)
Overall Height . . . . . 10.33 ft (3150 mm)
Empty Weight . . . . . 11,023 - 19,842 lbs (5000 - 9000 kg)
Gross Weight . . . . . 14,661 - 25,904 lbs (6650 - 11750 kg)
Passenger Space (Design Load) . . . . . Data unavailable
Doorway Width . . . . . 59.06 in (1500 mm)
Doorway Height . . . . . 72.83 in (1850 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . Four wheels with pneumatic tires
Design Load . . . . . 5,732 - 9,039 lbs
(2600 - 4100 kg)/front suspension wheel
5,732 - 9,039 lbs (2600 - 4100 kg)/rear suspension wheel
Lateral Guidance . . . . . Four guidewheels on vehicle with guiderails at both sides of guideway

PROPULSION & BRAKING:

Type & No. Motors . . . . . One dc shunt motor, forced-air ventilated
Motor Placement . . . . . On-board
Motor Rating . . . . . 73.8 HP, 55 kw at 2210 rpm
Type Drive . . . . . Gear drive (differential)
Gear Ratio 11:1
Type Power . . . . . 440 vac, 3ϕ, 300 max amp/motor with ac to dc conversion aboard vehicle
Power Collection . . . . . Rigid trolley wire and sliding shoe collector for each phase
Type Service Brakes . . . . . Regenerative brake and pneumatic-hydraulic brake as back-up
Type Emergency Brakes . . . Regenerative brake and pneumatic brake
Emergency Brake Reaction Time . . . . . Less than 0.5 sec

SWITCHING:

Type & Emplacement . . . . . Submerging and emerging guiderail type, located in the guideway
Switch Time (lock-to-lock) . . . . . 3 sec
Speed Thru Switch . . . . . 12.4 mph (20 km/h) max
Headway Thru Switch . . . . . 13 sec min for 6-vehicle trains of 29.86 ft (9.1 m) long vehicles at 12.4 mph (20 km/h) [f]

GUIDEWAY:

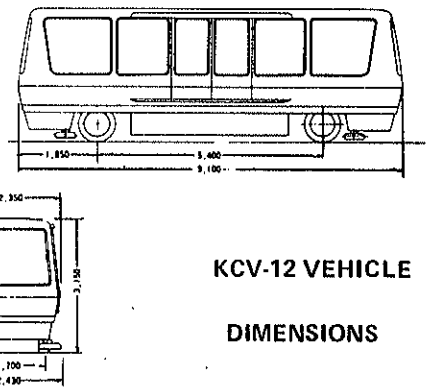
Type . . . . . At, above and below-grade dual running surfaces
Materials . . . . . Steel or concrete
Running Surface Width . . . . . 1.31 ft (400 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 131 ft (40000 mm)
Overall Cross Section Width . . . . . 9.84 ft (3000 mm)
Overall Cross Section Height . . . . . Data unavailable
Design Load . . . . . Data unavailable
Double Lane Elevated Guideway:
Max Elevated Span . . . . . 98.4 ft (30000 mm)
Overall Cross Section Width . . . . . 19.68 ft (6000 mm)
Overall Cross Section Height . . . . . Data unavailable
Design Load . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . Through stations
Type Elevated Guideway Support Columns . . . . . Information unavailable

CONTROL:

A central computer governs schedules, determines routes, start/stop, cruise speed, etc., and also can perform system checkout and institute emergency actions. Headway is controlled via a fixed-block system. The Automatic Train Control system prevents collision and merging conflicts and contains an independent back-up system. In the event of central computer shut down, manual control of the vehicle is provided.

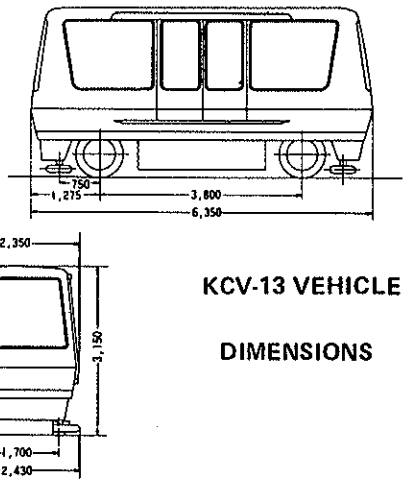
STATIONS:

Stations are designed to be unattended with operation similar to an elevator lobby.



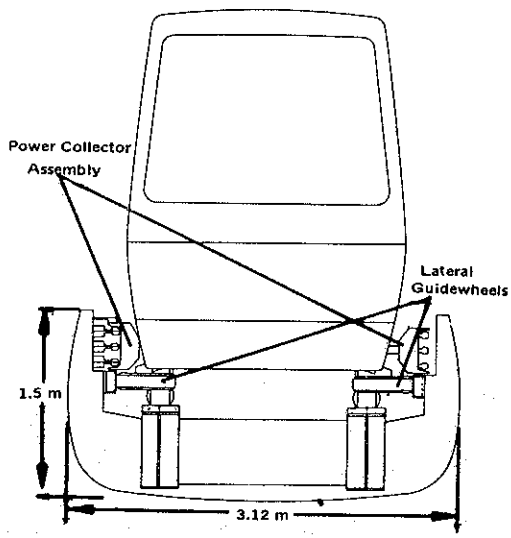
KCV-12 VEHICLE DIMENSIONS

Dimensions in mm

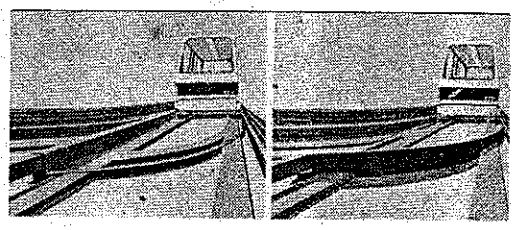


KCV-13 VEHICLE DIMENSIONS

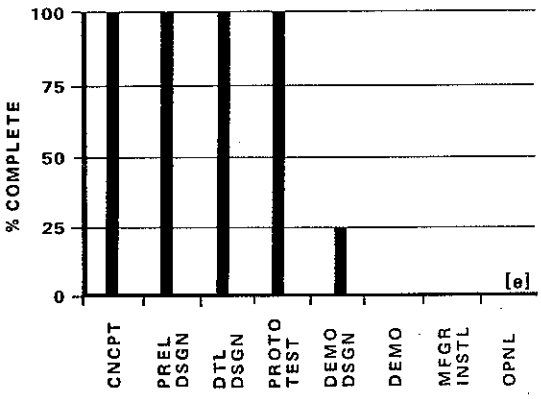
Dimensions in mm



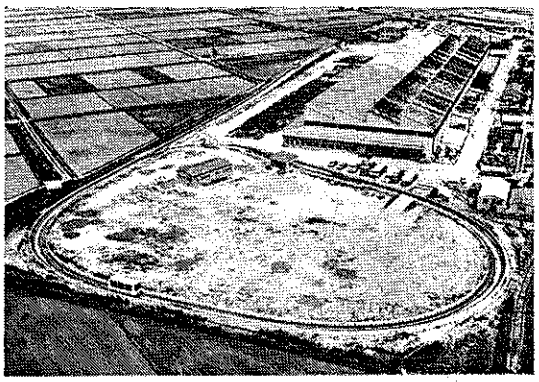
VEHICLE ON GUIDEWAY



GUIDEWAY SWITCH



DEVELOPMENT STATUS



VIEW OF TEST TRACK

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Development history unavailable at time of printing

INSTALLATIONS & CONTRACTS:

A full scale prototype test with computer-controlled operation is being run at present. Guideway consists of loop, siding and straight lines and a total length of 2132 ft (650 m). One off-line station and two vehicles are being tested.

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY: [e: except as noted]

Single Lane Guideway Envelope Width . . . . . 10.24 ft (3120 mm)
Single Lane Guideway Envelope Height . . . . . 12.83 ft (3190 mm)
Single Lane Guideway Structural Weight . . . . . 4,000 lbs/ft (6000 kg/m) [b]
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 10%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 65.62 ft (20 m)
Construction Process . . . . . Prefabricated guideway sections
Staging Capability . . . . . Section loops can be operated while others are under construction.

LIMITATIONS:

Permission of standees limits accel/decel to approx 4.5 ft/sec^2 (1.37 m/s^2).

Guideway Diverter switch and fixed-block headway control system limits reduction of headway to greater than 3 sec.

On-line stations limit headway to approx 60 - 70 sec.

ENVIRONMENTAL IMPACT: [e]

Emissions . . . . . No direct pollution emissions
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 4.92 ft (1500 mm), H_2 – 12.89 ft (3930 mm)
W_1 – 10.23 ft (3120 mm), W_2 – 10.23 ft (3120 mm)
P_1 – 10.20 ft (3110 mm), P_2 13.78 ft (4200 mm)
Noise . . . . . Data unavailable

CENTRAL CONTROL ROOM OF TEST TRACK

KOMPAKTBAHN

CLASSIFICATION: Light Guideway Transit

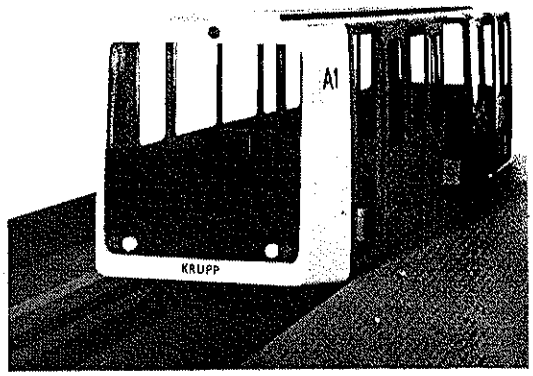
OTHER NAMES: None

DEVELOPER: Fried. Krupp GMBH
Krupp Industrie-und Stahlbau
41 Duisburg-Rheinhausen
Franz-Schubert-Strasse 1-3
West Germany
Tel: (02135) 781

LICENSEES: None

PATENTS: None

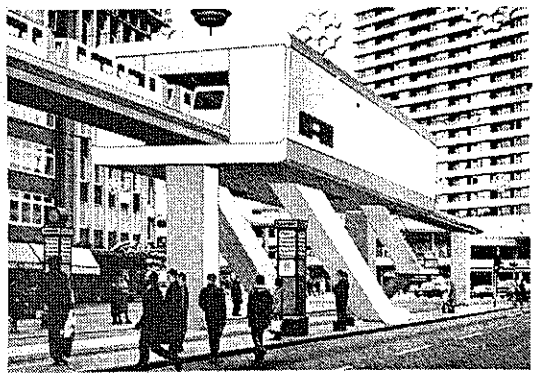
DATA REFERENCE CODE: [b 11: except as noted]



TYPICAL VEHICLE

SYSTEM DESCRIPTION:

The Kompaktbahn is an urban personal rapid transit system especially designed for transportation tasks in medium sized towns. The system's max capacity, 9,500 to 14,400 passengers per hour and direction, fills the gap between underground and bus capacity. The Kompaktbahn vehicles are supported on flanged steel wheels running on conventional steel rails. The cruising speed will be 21 mph (33 km/h). The system operation is designed for scheduled service with fixed intervals (nominal headway 60 sec). Operation will be fully automated.



TYPICAL STATION

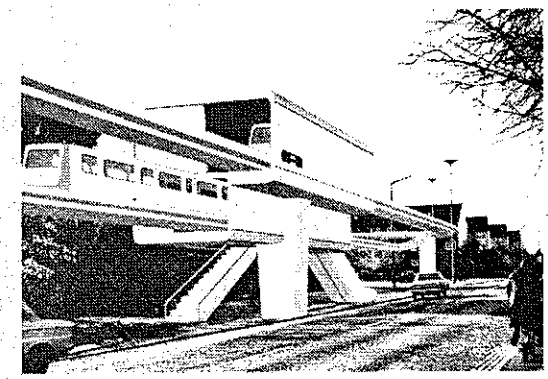
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

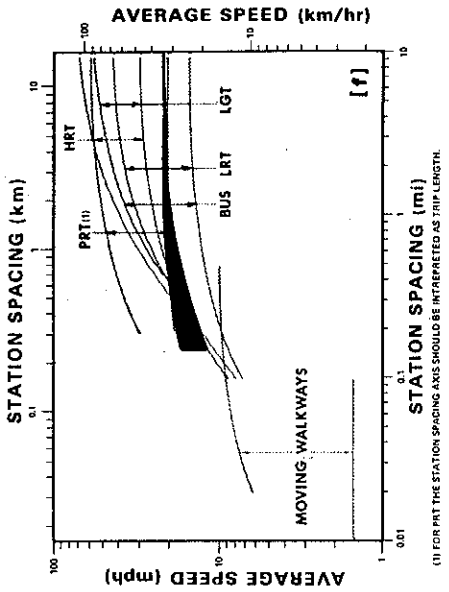
Max Theoretical One-Way Capacity	14,400 psgr/hr
Max Practical One-Way Capacity	10,500 psgr/hr
Min Theoretical Headway	60 sec
Min Practical Headway	75 sec
Availability	Scheduled
Type Service	Point-to-point collection and distribution
Type Network	Linear and grid
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles and vehicle trains

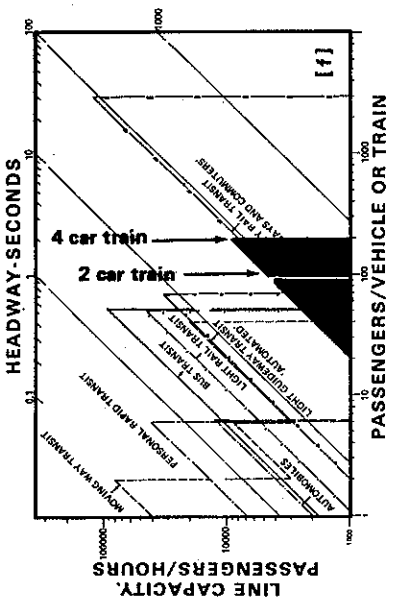
VEHICLE PERFORMANCE:

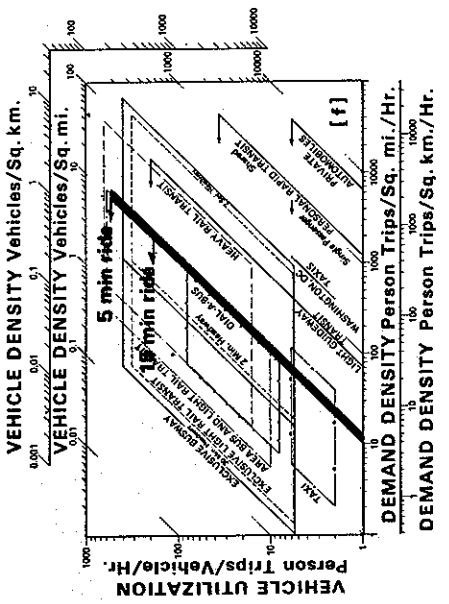
Cruise Velocity	21 mph (33 km/h)
Max Velocity	44 mph (70 km/h)
Max Grade	±10%
Service Acceleration	4.3 ft/s^2 (1.3 m/s^2)
Service Deceleration	4.3 ft/s^2 (1.3 m/s^2)
Max Jerk	3.3 ft/s^3 (1 m/s^3)
Emergency Decel	8.5 ft/s^2 (2.6 m/s^2)
Stopping Precision in Station	39.4 in (±1000 mm)
Degradation if Guideway is Wet	25 - 30%



VEHICLE







Degradation for Ice & Snow . . . . . 25 - 30%
Vehicle Design Capacity . . . . . 24 seated 24 standing
Vehicle Crush Capacity . . . . . 24 seated 48 standing
Energy Consumption, Accelerating and Decelerating Only
Empty Vehicle . . . . . Data unavailable
At Design Capacity . . . . . Data unavailable
Energy Consumption, Cruise Only
Empty Vehicle . . . . . Data unavailable
At Design Capacity . . . . . 1.8 kwh/veh-mi (1.1 kwh/veh-km)

STATIONS:

Type . . . . . On-line
Type Boarding . . . . . Level, standing still
Ticket or Fare Collection . . . . . Automatic ticket machine
Security . . . . . Closed circuit TV
Boarding Capacity . . . . . 8,776 psgr/hr/berth
Deboarding Capacity . . . . . 8,776 psgr/hr/berth
Max Wait Time . . . . . 60 sec to 5 min
Vehicle in Station Dwell Time . . . . . 20 sec
Average Station Spacing . . . . . 0.4 mi (0.7 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . Yes
Stops . . . . . Stops at each station
Accommodation . . . . . Seated and standing
Comfort . . . . . Heating and ventilation
Security . . . . . Data unavailable
Instruction . . . . . Signs, information boards and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Headway control; if failure occures, system comes to complete stop.
Fail Operational Features . . . . . Not identified yet
Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Data unavailable
Strategy For Removal of Failed Vehicle . . . . . Hand operated drive to next station with diversion track
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Vehicle is removed by hand operated drive or passengers leave over emergency exit path.
System Lifetime . . . . . Data unavailable
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . Luggage and wheelchairs are possible.
Goods Movement . . . . . Possible

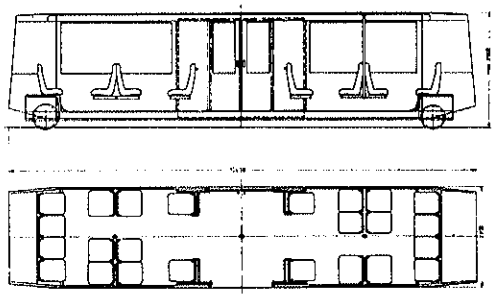
PERSONNEL REQUIREMENTS:

Typical System of 4 vehicles, 4 stations and 1.86 mi (3 km) of one-way guideway
No. of Operators/Vehicle . . . . . None
No. of Attendants/Station . . . . . None
No. of Administrative Personnel
No. of Central Control Attendants
No. of Maintenance Personnel
Engineering Staff
. . . . . Under study

PHYSICAL DESCRIPTION

VEHICLE:

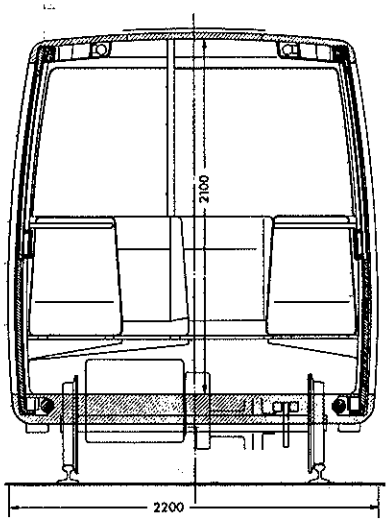
Overall Length . . . . . 36.1 ft (11000 mm)
Overall Width . . . . . 7.2 ft (2200 mm)
Overall Height . . . . . 8.2 ft (2500 mm)
Empty Weight . . . . . 24,250 lbs (11000 kg)
Gross Weight . . . . . 33,070 lbs (15000 kg)
Passenger Space (Design Load) . . . . . 6.24 ft^2 (0.58 m^2) seated
2.69 ft^2 (0.25 m^2) standing
Doorway Width . . . . . 55.1 in (1400 mm)
Doorway Height . . . . . 76.8 in (1950 mm)
Step Height . . . . . Level



VEHICLE LAYOUT

SUSPENSION:

Type . . . . . Four steel wheels; suspension system principles are still held confidential by developer.
Design Load . . . . . 16,538 lbs (7500 kg)/front suspension [e]
16,538 lbs (7500 kg)/rear suspension [e]
Lateral Guidance . . . . . Flanged wheels



VEHICLE CROSS SECTION

PROPULSION & BRAKING:

Type & No. Motors . . . . . Two dc motors
Motor Placement . . . . . Underfloor
Motor Rating . . . . . 75 kw at 3300 rpm
Type Drive . . . . . Data unavailable
Gear Ratio 1:3.6
Type Power . . . . . 600 - 750 vdc
Power Collection . . . . . By separate rail
Type Service Brakes . . . . . Motorbrakes
Type Emergency Brakes . . . . . Spring force brakes plus electromagnetic track brakes
Emergency Brake Reaction Time (i.e., time period from first sensing a failure to reaching full rated braking) . . . . . Data unavailable

SWITCHING:

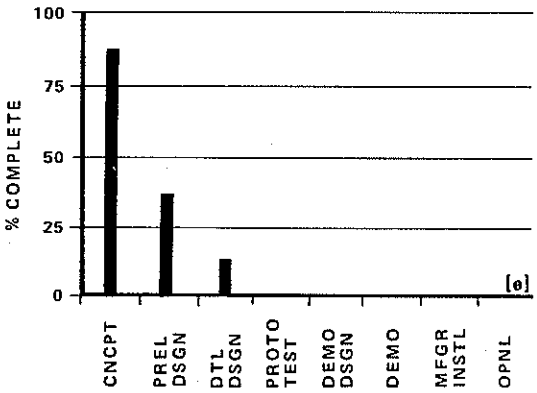
Type & Emplacement . . . . . Tongue switch/conventional rail switch

GUIDEWAY:

Type . . . . . Conventional steel rails; at, above or below level
Materials . . . . . Steel
Running Surface Width . . . . . 6.56 ft (2000 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 98.4 ft (30000 mm)
Overall Cross Section Width . . . . . 8.2 ft (2500 mm)
Overall Cross Section Height . . . . . 8.9 ft (2700 mm)
Design Load . . . . . Data unavailable
Double Lane Elevated Guideway:
Max Elevated Span . . . . . 98.4 ft (30000 mm)
Overall Cross Section Width . . . . . 18.7 ft (5700 mm)
Overall Cross Section Height . . . . . 8.9 ft (2700 mm)
Design Load . . . . . Data unavailable
Guideway Passenger Emergency Egress . . Emergency exit path, 700 mm width and 2000 mm height
Type Elevated Guideway Support Columns . . . . . Steel or concrete columns [b 14]

CONTROL:

The automatic railway control system includes a section control center for all automatic control functions of the sections, point operation section, automatic time table control section, station control, track computer and information system.



DEVELOPMENT STATUS

STATIONS:

On-line stations, one level and two level possible; berth width is 3 m for single track or 6 m for double track. Berth length is 30 m to 50 m depending on train length. Stairs are in the center or at the end. Station includes diversion track if necessary.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Financial assistance has been granted from the German Ministry for research and technology, BMFT.

INSTALLATIONS & CONTRACTS:

A test track of approx 3,280 ft (1000 m) length is planned.

COSTS:

Information unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width
Single Lane Guideway Envelope Height
Single Lane Guideway Structural Weight
Double Lane Guideway Structural Weight
. . . . . Data unavailable

Max Grade 15%
Min Vertical Turn Radius . . . . . 1640 ft (500 m) at 43.5 mph (70 km/h)
Min Horizontal Turn Radius . . . . . 196.8 ft (60 m) at 21.7 mph (35 km/h)
Construction Process . . . . . On-site construction or prefabricated
Staging Capability . . . . . Sections of line could be operated while other under construction

LIMITATIONS:

Data unavailable

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . Data unavailable
Noise . . . . . 70 dbA inside vehicle
80 dbA at 16.4 ft (5.0 m) outside

MAT (Mitsubishi Automatic Transportation System)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: Mitsubish Guideway Bus System

DEVELOPER: Mitsubishi Heavy Industries Ltd.
Rolling Stock & Transportation
Equipment Division
5-1 Marunouchi 2-chome
Chiyoda-ku, Tokyo, Japan

Mitsubishi Electric Corp.
Heavy Mashinery Division
2-3 Marunouchi 2-chome
Chiyoda-ku, Tokyo, Japan

LICENSEES: None

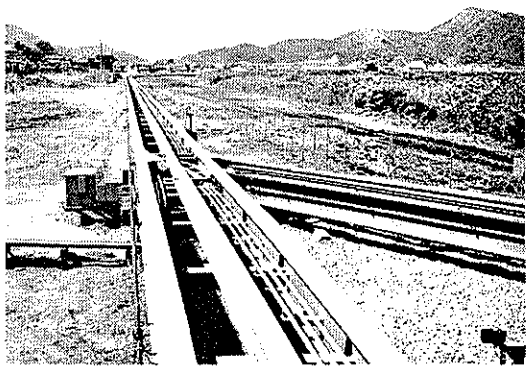
PATENTS: About 20 patents

DATA REFERENCE CODE: [a: except as noted]

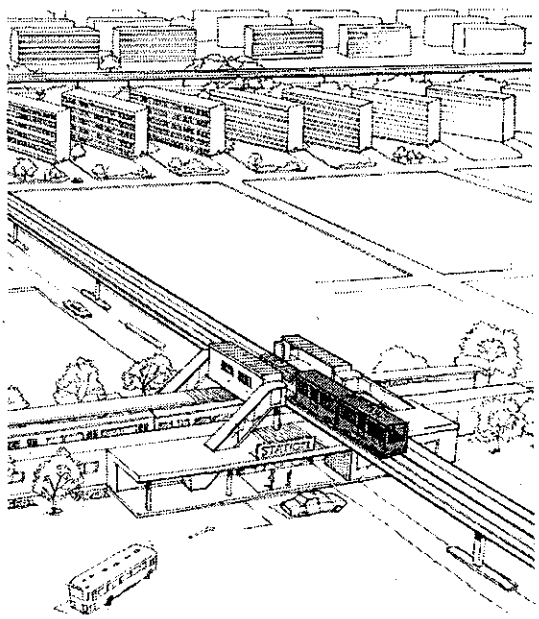
SYSTEM DESCRIPTION:

MAT is a Light Guideway Transit system with medium transportation capacity. It utilizes 32-passenger vehicles which can run as single vehicles and also in trains with up to 10 vehicles, over an exclusive guideway. The vehicles run on rubber tires over a pair of steel running surfaces. The system is fully automated by means of computer control. Service is collection and distribution as a line-haul or in loops of 3 to 10 mi (5-16 km).

PROTOTYPE VEHICLE ON TEST TRACK



PROTOTYPE TEST TRACK

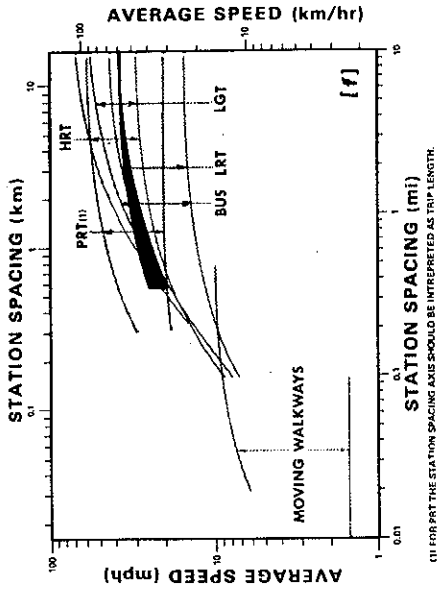


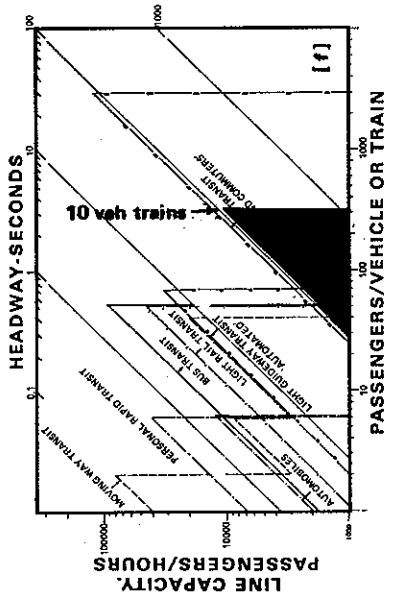
ARTIST VIEW OF INTERFACE WITH RAIL AND BUS MODES

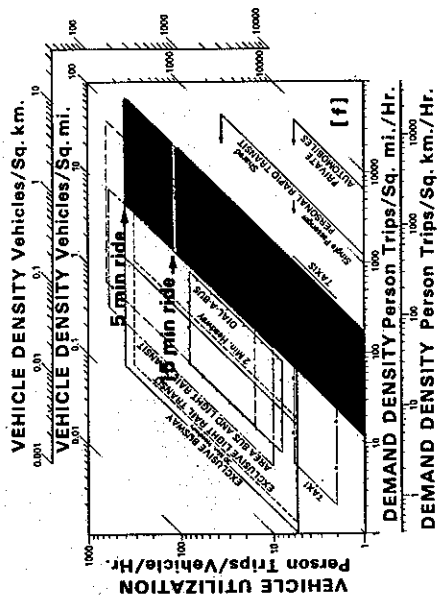
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	15,000 psgr/hr
Max Practical One-Way Capacity	15,000 psgr/hr
Min Theoretical Headway	90 sec
Min Practical Headway	108 sec
Availability	Scheduled and on-demand
Type Service	Limited area collection and distribution
Type Network	Line-haul or loops
Type of Vehicle Routing	Fixed
Traveling Unit	Up to 10-vehicle trains







VEHICLE PERFORMANCE:

Cruise Velocity	37 mph (60 km/h)
Max Velocity	37 mph (60 km/h)
Max Grade	±10%
Service Acceleration	3.64 ft/s^2 (1.11 m/s^2)
Service Deceleration	3.64 ft/s^2 (1.11 m/s^2)
Max Jerk	Data unavailable
Emergency Decel	5.47 ft/s^2 (1.67 m/s^2)
Stopping Precision in Station	Data unavailable
Degradation if Guideway is Wet	Data unavailable
Degradation for Ice & Snow	Data unavailable
Vehicle Design Capacity	16 seated 16 standing
Vehicle Crush Capacity	16 seated 34 standing

STATIONS:

Type	On-line
Type Boarding	Level
Ticket or Fare Collection	Automated
Security	Closed circuit TV
Boarding Capacity	2,000 psgr/hr/berth
Deboarding Capacity	2,000 psgr/hr/berth
Max Wait Time	90 sec
Vehicle in Station Dwell Time	Approx 20 sec
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles.
Transfers	As required
Stops	Vehicles stop for other passengers.
Accommodation	Seated and standing
Comfort	Heating and air conditioning
Security	Intercom
Instruction	Signs and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Both driving and guiding wheels have auxiliary wheels which can take the vehicle to the station safely at lower speed when any tire is punctured.

Fail Operational Features . . . . . Information unavailable

Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
Strategy For Removal of Failed Vehicle
. . . . . Data unavailable

Strategy for Passenger Evacuation of Failed Vehicle . . . . . Passengers can evacuate via the refuge walkway on the track.

System Lifetime . . . . . Data unavailable

Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Requirements are expected to be similar to those of convential railways.

CARGO CAPABILITY:

Passenger Articles	Small packages and luggage
Goods Movement	As required

PERSONNEL REQUIREMENTS:

Information unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 21 ft (6400 mm)
Overall Width . . . . . 7.2 ft (2200 mm)
Overall Height . . . . . 9.5 ft (2900 mm)
Empty Weight . . . . . 10,000 lbs (4536 kg)
Gross Weight . . . . . 15,180 lbs (6886 kg)
Passenger Space (Design Load) . . . . . 2.78 ft^2 (1.26 m^2) seated
3.64 ft^2 (0.33 m^2) standing
Doorway Width . . . . . 47.24 in (1200 mm)
Doorway Height . . . . . 70.87 in (1800 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . 4 pneumatic tired wheels each vehicle (automatic type)
Design Load . . . . . 16,000 lbs (7257 kg)/vehicle
Lateral Guidance . . . . . Horizontal rubber wheels on vehicles constrained to center guiderail

PROPULSION & BRAKING:

Type & No. Motors . . . . . One dc motor
Motor Placement . . . . . On vehicle
Motor Rating . . . . . 87 HP, 65 kw
Type Drive . . . . . Traction drive
Type Power . . . . . 550 vac, 3ϕ
Power Collection . . . . . .Power shoes riding on 3 solid power lines
Type Service Brakes . . . . . Air brake
Emergency Brake Reaction Time . . . . . 0.9 sec

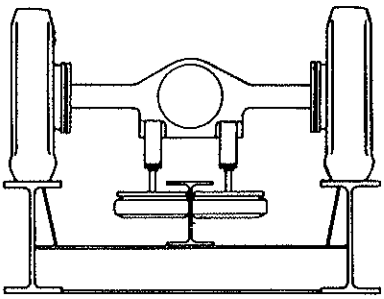
SWITCHING:

Type & Emplacement . . . . . .Electrohydraulic, physically moved guideway surfaces
Switch Time (lock-to-lock) . . . . . 6 sec
Speed Thru Switch . . . . .Variable; depending on radius of curvature
Headway Thru Switch . . . . . 108 sec min

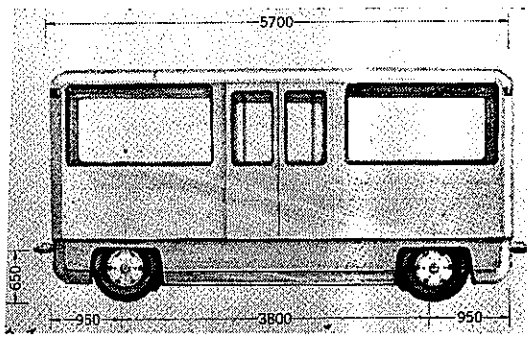
GUIDEWAY:

Type . . . . .Dual running I-beam surfaces with center guidance I-beam
Materials . . . . . Steel on reinforced concrete
Running Surface Width . . . . 0.98 ft (300 mm) at 5.58 ft (1700 mm) centers

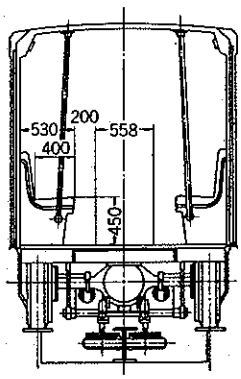
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 49 ft (15000 mm)
Overall Cross Section Width . . . . . 6.56 ft (2000 mm)
Overall Cross Section Height . . . . . 1.97 ft (600 mm)
Design Load . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . Over pedestrian alley
Type Elevated Guideway Support Columns . . . .Reinforced concrete or steel tube, T-type or I-type

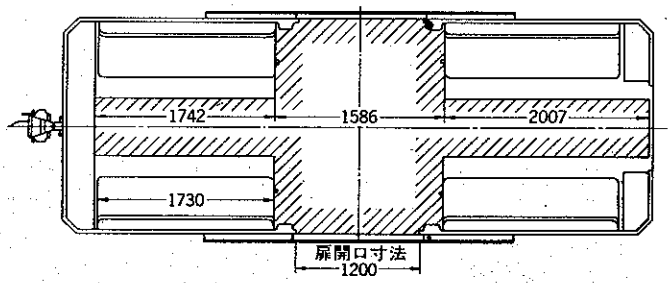


SUSPENSION AND GUIDANCE SYSTEMS

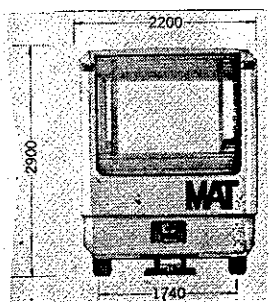


VEHICLE SIDE VIEW

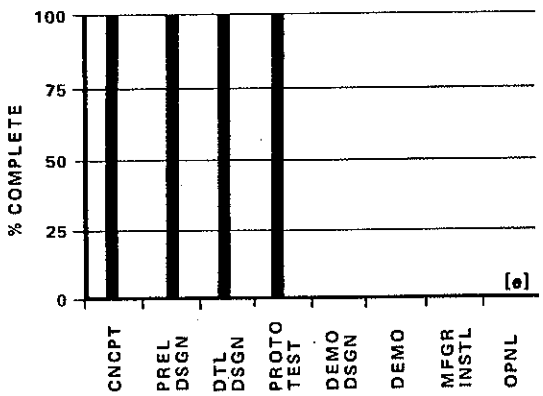




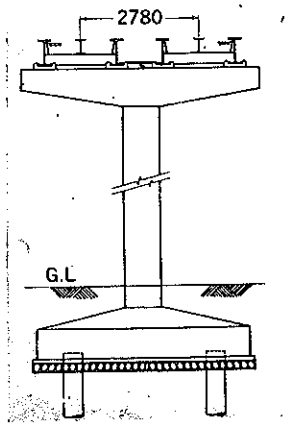
VEHICLE PLAN VIEW



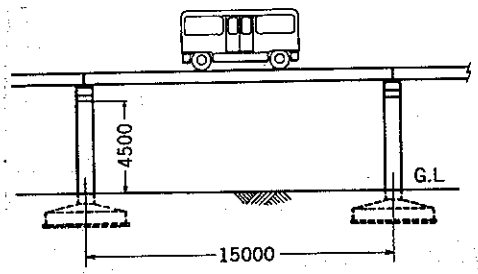
VEHICLE END VIEWS



DEVELOPMENT STATUS



DOUBLE ELEVATED GUIDEWAY
CROSS SECTION



ELEVATED GUIDEWAY
SIDE VIEW

CONTROL:

The control system is a flexible hierarchy system consisting of a central computer which controls train groups the regional computer controlling each train. Lossy coaxial cables with high reliability are used for communicating data between the vehicle and wayside in the control system.

Thus operation status and verbal communications from the passengers are continuously fed to the central control. Automatic train control, consisting of a fixed control block system, is installed as a separate system.

STATIONS:

Enclosed on-line stations have automatic doors synchronized with vehicle doors. Stations are fully automated and monitored from the central control room by means of TV cameras. Intercom is provided.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Information unavailable

INSTALLATIONS & CONTRACTS:

A test track of 2,329 ft (710 m) is in operation.

COSTS:

Information unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 8.6 ft (2620 mm)
Single Lane Guideway Envelope Height . . . . . 12.2 ft (3710 mm)
Single Lane Guideway Structural Weight . . . . . Approx 305 lbs/ft (454 kg/m)
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 10%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 30.5 ft (93 m)
Construction Process . . . . . Prefabricated guideway sections
Staging Capability . . . . . Sections may be operated while others are under construction.

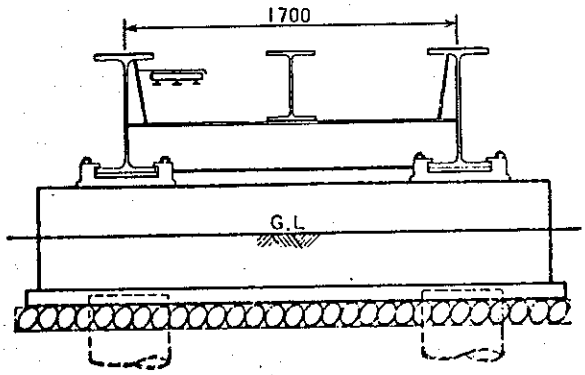
LIMITATIONS: [e]

Installations expected to be limited to line-haul or loop applications.

Permittance of standees limits service accel/decel to approx 4.4 ft/s^2 (1.34 m/s^2).

ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . Insufficient data for assessment
Noise . . . . . 64 dbA at 91.5 ft (30 m) from guideway, 58 dbA inside vehicle at a vehicle velocity 37 mph (60 km/hr)



SINGLE AT-GRADE GUIDEWAY
CROSS SECTION

MINI-MONORAIL

CLASSIFICATION: Light Guideway Transit

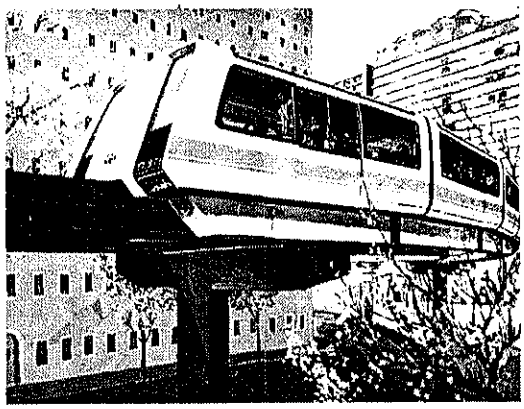
OTHER NAMES: None

DEVELOPER: TOKYO SHIBAURA ELECTRIC CO., LTD.
Transportation Equipment Division
1-6, 1-chome Uchisaiwaicho
Chiyoda-ku, Tokyo, 100, Japan
Tel: TOKYO (03) 501-5411

LICENSEES: None

PATENTS: Under application in Japan

DATA REFERENCE CODE: [c 12]

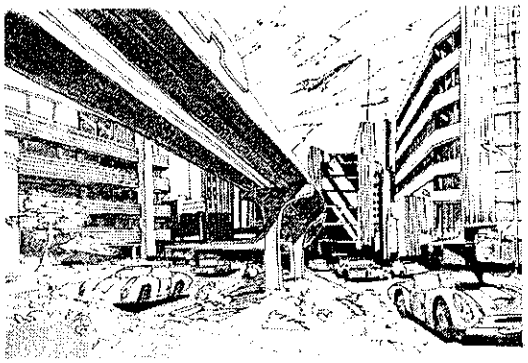


TYPICAL ELEVATED INSTALLATION

SYSTEM DESCRIPTION:

The Mini-Monorail is a medium capacity system for transporting passengers along a line or around loops for point-to-point or collection and distribution service. The developer proposes that the system be applied in new towns, circulation in other transportation terminals and large factories, and as the connecting link between towns and inter-city transportation facilities.

Trains are formed of up to 12 small rubber tired vehicles. The coupling between vehicles is an articulated joint with a common truck. Proven automatic train control and automatic train operation techniques are used with a central computer which controls the system. A driver is aboard each train to monitor and control the train.



TYPICAL ELEVATED INSTALLATION

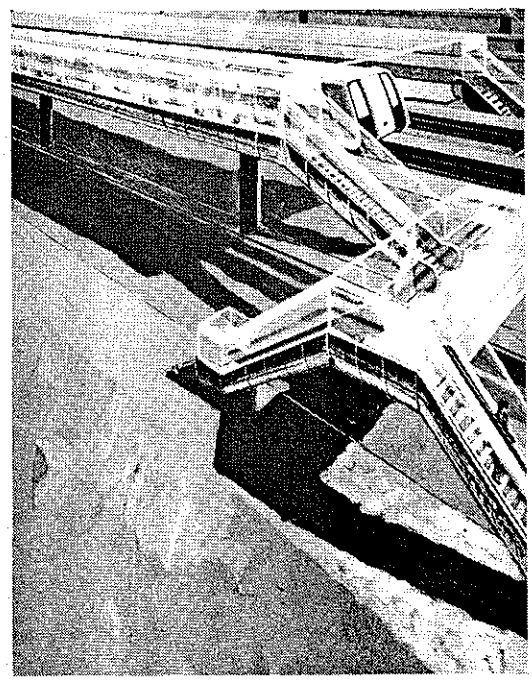
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	15,300 psgr/hr
Max Practical One-Way Capacity	10,200 psgr/hr
Min Theoretical Headway	90 sec
Min Practical Headway	120 sec
Availability	Scheduled and on-demand
Type Service	Limited area and point-to-point
Type Network	Linear or loops
Type of Vehicle Routing	Fixed
Traveling Unit	2 - 12 vehicle trains

VEHICLE PERFORMANCE:

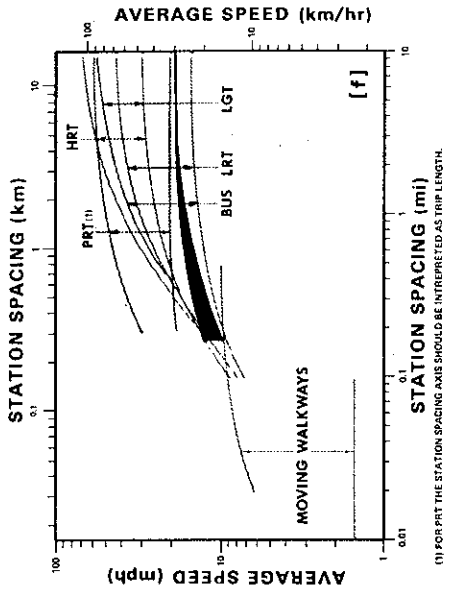
Cruise Velocity	18.6 mph (30 km/h)
Max Velocity	37.3 mph (60 km/h)
Max Grade	10%
Service Acceleration	1.84 ft/s^2 (0.56 m/s^2)
Service Deceleration	2.76 ft/s^2 (0.84 m/s^2)
Max Jerk	3.94 ft/s^3 (1.2 m/s^3)
Emergency Decel	4.10 ft/s^2 (1.25 m/s^2)
Stopping Precision in Station	11.9 in (300 mm)
Degradation if Guideway is Wet	Max grade degraded to 5%
Degradation for Ice & Snow	Max grade degraded to 5%
Vehicle Design Capacity	D[1] - 4 seated D - 9 standing
	F[2] - 8 seated F - 17 standing
Vehicle Crush Capacity	D - 4 seated D - 12 standing
	F - 8 seated F - 22 standing

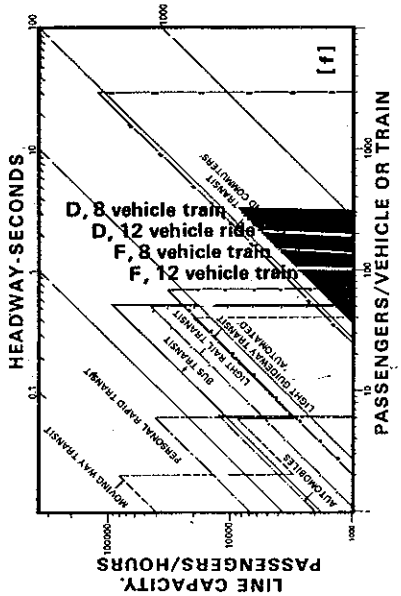


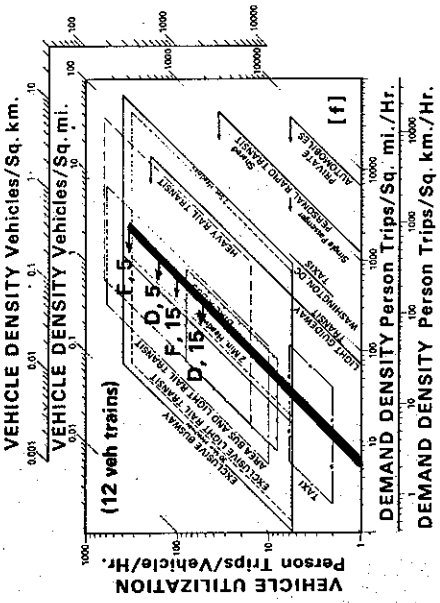
TYPICAL ELEVATED STATION

[1] D - Driving vehicle

[2] F - Following vehicle







Energy Consumption, Accelerating and Decelerating Only
- Empty Vehicle . . . . . 12 kwh/veh-mi (7.5 kwh/veh-km)
- At Design Capacity . . . . . 14.8 kwh/veh-mi (9.2 kwh/veh-km)

Energy Consumption, Cruise Only
- Empty Vehicle . . . . . 0.61 kwh/veh-mi (0.38 kwh/veh-km)
- At Design Capacity . . . . 0.76 kwh/veh-mi (0.47 kwh/veh-km)

STATIONS:

Type . . . . . On-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automated
Security . . . . . Closed circuit TV
Boarding Capacity . . . . . 10,200 psgr/hr
Deboarding Capacity . . . . . 10,200 psgr/hr
Max Wait Time . . . . . 2 min
Vehicle in Station Dwell Time . . . . . Approx 20 sec
Average Station Spacing . . . . . 0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles
Transfers . . . . . Yes, if multiple loops or lines installed
Stops . . . . . Stops for other passengers at each station
Accommodation . . . . . Seated and standing
Comfort . . . . . Air conditioned vehicles
Security . . . . . Closed circuit TV in stations
Instruction . . . . . Signs and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . Main equipment of ATC apparatus have backup systems. A reset system is provided to prevent vehicle collision.
Fail Operational Features . . . . . The backup central computer system can function under manual operation of system.
Total System Mean Time Before Failure . . . . . Approx 30 hrs
System Restore Time After Failure . . . . . 0.1 hrs
Station Mean Time Before Failure . . . . . 5,000 hrs
Station Restore Time After Failure . . . . . 0.5 hrs
Vehicle Mean Time Before Failure . . . . . 6,000 hrs
Strategy For Removal of Failed Vehicle . . . . . Connected and evacuated with relief train
Strategy For Passenger Evacuation of Failed Vehicles . . . . . Evacuated by gangway which is established in guideway
System Lifetime . . . . . 10 years
Vehicle Lifetime . . . . . 10 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed)
- Guideway . . . . . 3 hrs every 7 days
- Station . . . . . 2 hrs every 7 days
- Vehicle . . . . . 0.25 hrs every day

Periodic Maintenance . . . . . .
- Guideway . . . . . 8 hrs every 30 days/0.62 mi (1 km)
- Station . . . . . 8 hrs every 365 days
- Vehicle . . . . . 24 hrs every 365 days

Adjustments Required . . . . . Brake adjustments, pneumatic pressure of wheel adjustments
Other Maintenance . . . . . Vehicle maintenance, 48 hrs every 3 years

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages and luggage
Goods Movement . . . . . Not provided

PERSONNEL REQUIREMENTS:

Typical System of 216 vehicles, 9 stations and 4.2 mi (6.7 km) of two-way guideway
No. of Operators/Vehicle . . . . . 1 operator per 5 vehicles
No. of Attendants/Station . . . . . 4 attendants per station
No. of Administrative Personnel 5
No. of Central Control Attendants . . . . . 1/8 hrs
No. of Maintenance Personnel 18
Engineering Staff 4

[1] D - Driving Vehicle
[2] F - Following Vehicle

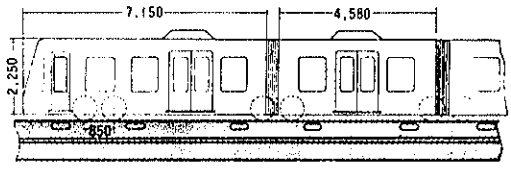
PHYICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . D - 23.5 ft (D - 7150 mm)
F - 15.0 ft (F - 4580 mm)
Overall Width . . . . . 6.56 ft (2000 mm)
Overall Height . . . . . 7.87 ft (2400 mm)
Empty Weight . . . . . D - 13,669 lbs (D - 6200 kg)
F - 7,716 lbs (F - 3500 kg)
Gross Weight . . . . . D - 15,388 lbs (D - 6980 kg)
F - 11,023 lbs (F - 5000 kg)

Passenger Space (Design Load)
D - 14 ft^2 (D - 1.3 m^2) seated
F - 28 ft^2 (F - 2.6 m^2) seated
D - 24 ft^2 (D - 2.24 m^2) standing
F - 44 ft^2 (F - 4.09 m^2) standing

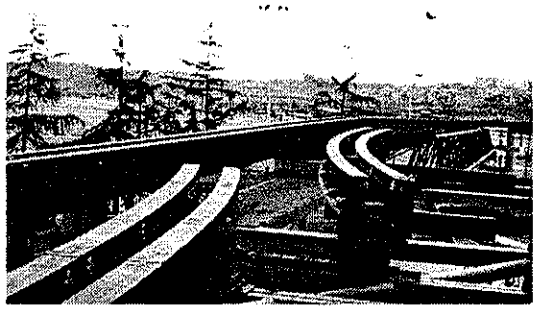
Doorway Width . . . . . 47.2 in (1200 mm)
Doorway Height . . . . . 70.9 in (1800 mm)
Step Height . . . . . 3.9 in (100 mm)



VEHICLE/TRAIN DIMENSION

SUSPENSION:

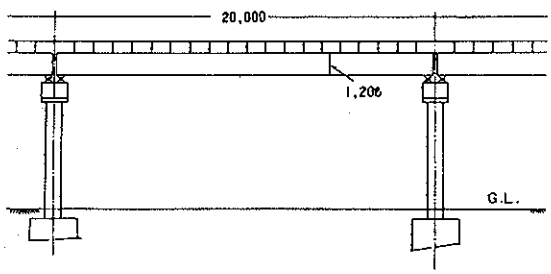
Type . . . . . Supported by pneumatic rubber tires, 4 each per truck, one truck per articulated joint; type, secondary suspension
Design Load . . . . . 5,512 lbs (2500 kg)/front suspension
5,512 lbs (2500 kg)/rear suspension
Lateral Guidance . . . . . Supported by pneumatic rubber tires, 4 each per truck



GUIDEWAY SWITCH

PROPULSION & BRAKING:

Type & No. Motors . . . . . dc electric motors (250 vdc), direct traction drive
Motor Placement . . . . . One motor each driving truck
Motor Rating . . . . . 60 HP, 45 kw at 1,620 rpm
Type Drive . . . . . Right angle cardon drive
Gear Ratio 7.00:1
Type Power . . . . . 400/440 vac, 3ϕ, or 600 vdc
Power Collection . . . . . Power collectors on vehicle, power rail on guideway
Type Service Brakes . . . . . Dynamic regenerative electric and disc brakes
Type Emergency Brakes . . . . . Pneumatic disc brakes
Emergency Brake Reaction Time (i.e., time period from first sensing a failure to reaching full rated braking) . . . . . 3 sec



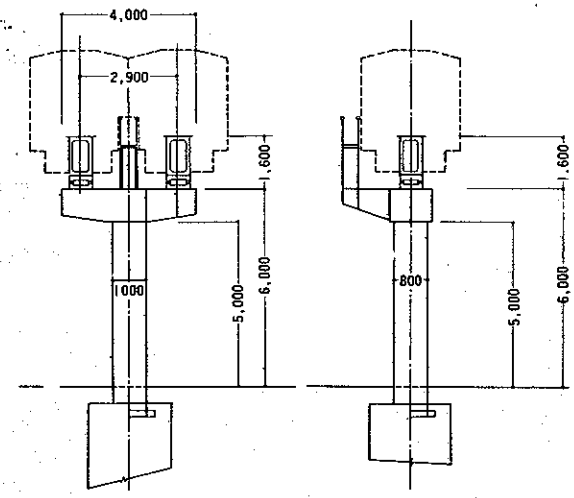
Dimensions in mm

SWITCHING:

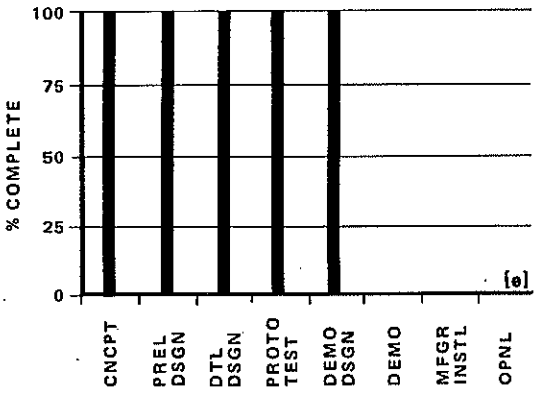
Type & Emplacement . . . . . Horizontally moved guideway section, on-guideway
Switch Time (lock-to-lock) . . . . . 8 sec
Speed Thru Switch . . . . . 18.6 mph (30 km/h) max
Headway Thru Switch . . . . . 30 sec min

GUIDEWAY:

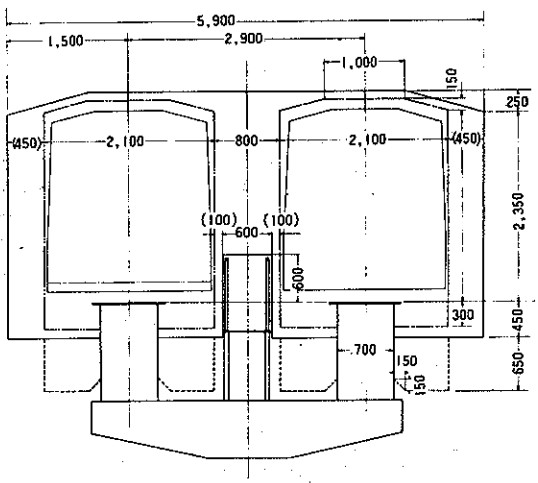
Type . . . . . Box beam
Materials . . . . . Welded steel
Running Surface Width . . . . . 2.95 ft (900 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 98.4 ft (30000 mm)
Overall Cross Section Width . . . . . Approx 8.2 ft (2500 mm) [f]
Overall Cross Section Height . . . . . 5.9 ft (1800 mm)
Design Load . . . . . 1,059 lbs/ft (1575 kg/m)
Double Lane Elevated Guideway:
Max Elevated Span . . . . . 98.4 ft (30000 mm)
Overall Cross Section Width . . . . . 13.1 ft (4000 mm)
Overall Cross Section Height . . . . . 5.9 ft (1800 mm)
Design Load . . . . . 2,119 lbs/ft (1800 kg/m)
Guideway Passenger Emergency Egress . . . . . Gangway which is established in elevated guideway
Type Elevated Guideway Support Columns . . . . . Welded steel columns and steel armored concrete columns



ELEVATED GUIDEWAY DIMENSIONS



DEVELOPMENT STATUS



INSTALLATION ENVELOP DIMENSIONS

CONTROL:

Standard proven train control utilizing fixed block headway control with an operator aboard each vehicle; automatic train control, automatic train operation and a central computer are employed.

STATIONS:

Enclosed platforms with access via escalators, dimension requirements of 230 ft (70 m) length for a 12 vehicle train and 13.1 ft (4 m) wide

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The system has been completed through prototype testing. Developer will provide specific designs tailored to site-specific requirements.

INSTALLATIONS & CONTRACTS:

Under proposal at Nanko in Osaka Pre. and Tokadai New Town in Aichi Pre.

COSTS:

Based upon typical system of 4.2 mi (6.7 km) double-lane guideway, 9 stations, 216 vehicles, 50,650 veh-mi/day, 1,680 veh-hr/day, 19 hrs operation per day

Capital Cost . . . . . Total Avg of $9,000,000/mi ($5,6000,000/km) double-lane

(Capital costs do not include computers.)

Avg Cost per Double-Lane Guideway $3,500,000/mi ($2,200,000/km)

Avg Cost Per Station $550,000

Computers, Software, & Control Center $57,000,000

Maintenance & Storage Facilities $3,000,000

Power Distribution & Substations $2,900,000

Operation & Maintenance Costs . . . . . Fixed Cost $13,400/weekday + Variable Cost $5,090/weekday

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	10.66 ft (3250 mm)
Single Lane Guideway Envelope Height	13.78 ft (4200 mm)
Single Lane Guideway Structural Weight	282 lbs/ft (420 kg/m)
Double Lane Guideway Structural Weight	530 lbs/ft (790 kg/m)
Max Grade	10%
Min Vertical Turn Radius	3,280 ft (1000 m) at 37.3 mph (60 km/h)
Min Horizontal Turn Radius	65.6 ft (20 m) at 12.4 mph (20 km/h)
Construction Process	Prefabricated guideway sections and columns
Staging Capability	Sections or loops can be installed and operated while others are under construction.

LIMITATIONS:

On-line stations and stops at each station decrease average velocity and limit minimum headway. Standing passengers would limit accel/decel to 4.5 ft/s^2 (1.37 m/s^2). Overall guideway and vehicle size would limit retrofit installation to uncrowded sites.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions

Visual, Single Lane Elevated Guideway . . . . .

H_1 – 5.9 ft (1800 mm), H_2 – 11.8 ft (3600 mm)

W_1 – 6.6 ft (2000 mm), W_2 – 9.2 ft (2800 mm)

P_1 – 9.3 ft (2830 mm), P_2 – 14.7 ft (4480 mm)

Noise . . . . . Approx 70 dbA inside vehicle approx 75 dbA at 32.8 ft (10 m) to side

MINITRAM—
HAWKER SIDDELEY DYNAMICS LIMITED

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Hawker Siddeley Dynamics Ltd.
Hatfield
Hertfordshire, AL10 9LL
England
Tel: Hatfield 62300
Cables: Hawsidyn Telex Hatfield
Telex: 22324

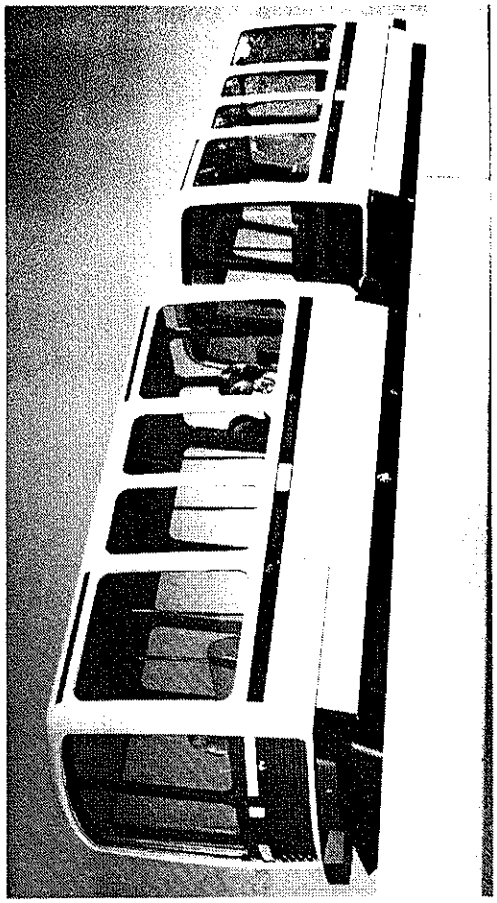
LICENSEES: Hawker Siddeley of Canada Ltd.
Box 6001
Toronto AMF, Ontario
Canada L5P 1B3
Tel: (416) 677-3250

PATENTS: Data unavailable

DATA REFERENCE CODE: [a 51: except as noted]

SYSTEM DESCRIPTION: [a]

"Minitram" is the name given to the concept of small vehicles accommodating 10 or more passengers running on rubber tired wheels under total automatic control over exclusive guideways. Service is collection and distribution along a line, around loops, or within a limited area. The vehicles can be operated on fixed schedules or on-demand as single units or in small trains of 2 or 3.



HSD MINITRAM MODEL

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	12,960 psgr/hr [f]
Max Practical One-Way Capacity	10,368 psgr/hr [f]
Min Theoretical Headway	10 sec
Min Practical Headway	12 sec [f]
Availability	Fixed schedules or on-demand
Type Service	Area collection and distribution
Type Network	Line, loop or network
Type of Vehicle Routing	Fixed schedule or passenger's select
Traveling Unit	Single vehicles or 2 to 3 veh trains

VEHICLE PERFORMANCE:

Cruise Velocity	33.6 mph (54.0 km/h)
Max Grade	10%
Service Acceleration	4.10 ft/s^2 (1.25 m/s^2)
Service Deceleration	4.10 ft/s^2 (1.25 m/s^2)
Max Jerk	4.10 ft/s^3 (1.25 m/s^3)
Emergency Decel	8.2 ft/s^2 (2.5 m/s^2)
Vehicle Design Capacity	6 seated 6 standing
Vehicle Crush Capacity	6 seated 17 standing

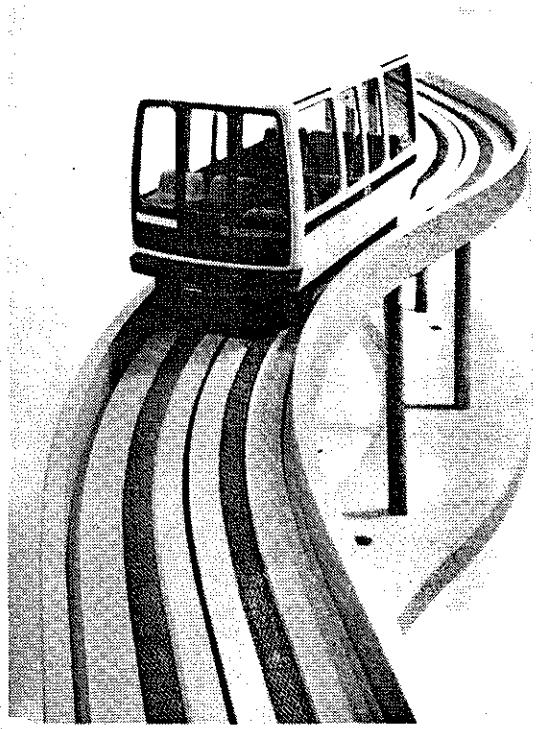
STATIONS:

Type	On line sequentially loaded vehicles
Type Boarding	Level
Security	Telephones in vehicles and closed circuit TV in stations
Vehicle in Station Dwell Time	15 sec
Average Station Spacing	0.2 mi (0.3 km)

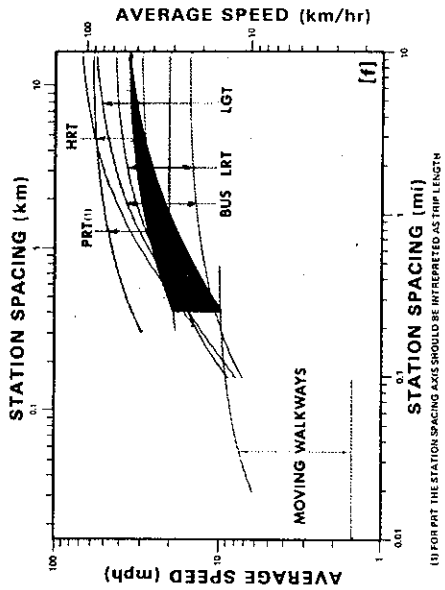
PUBLISHER'S NOTE:

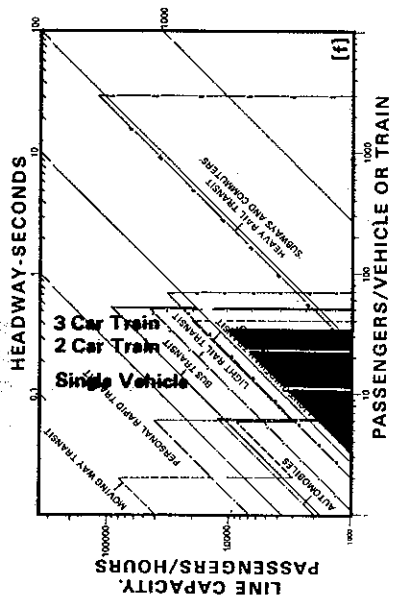
The developer has published data for two typical vehicles types; i.e., for airport shuttle with 100 passenger vehicles and for city application with 24 passenger vehicles.

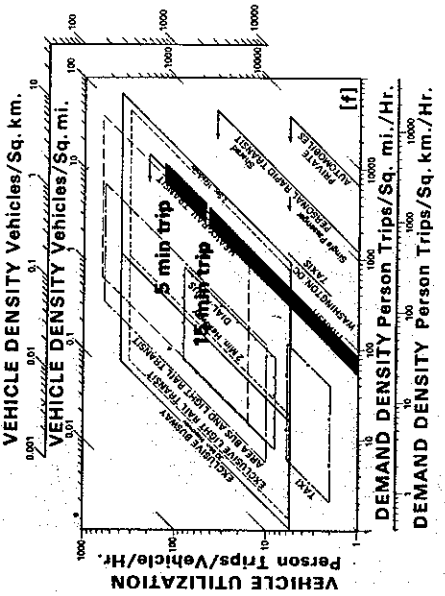
The data shown in these sheets apply for the smaller type, except as noted.



HSD MIDTRAM MODEL







INDIVIDUAL SERVICE:

Privacy . . . . . Vehicle shared with other passengers
Transfers . . . . . Not necessary in network [e]
Stops . . . . . Depending on mode of operation
Accommodation . . . . . Seated and standing
Comfort . . . . . Air conditioned where required
Security . . . . . Closed circuit TV in station

RELIABILITY & SAFETY:

Fail Safe Features . . . . . A duplicated fail-safe brake system operates the inboard rear and outboard front brakes in conjunction with the motor braking.
Fail Operational Features . . . . . The vehicle Health Monitor in the forward-mounted control equipment can receive alarm signals from sensors in the fire detection, brake, tire deflation, obstruction indicator, door interlock and passenger overload systems.
Meantimes Before Failure . . . . . Data unavailable
Lifetimes . . . . . Data unavailable

MAINTENANCE:

Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages and hand luggage [e]
Goods Movement . . . . . Vehicles can be adapted for goods movement [a]

PERSONNEL REQUIREMENTS:

Data unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 15.0 ft (4600 mm)
Overall Width . . . . . 6.6 ft (2000 mm)
Overall Height . . . . . 8.5 ft (2600 mm)
Empty Weight . . . . . 5600 lbs (2540 kg)
Gross Weight . . . . . Data unavailable
Doorway Width . . . . . 55 in (1400 mm)

SUSPENSION:

Type . . . . . Vertical suspension is provided by coil-springs augmented by gas spring/damper units that give constant level and constant ride comfort through the load range.

PROPULSION & BRAKING:

Type & No. Motors . . . . . The vehicle is propelled by a single 500-v, dc series traction motor acting through a reduction gear and differential on the rear wheels.
Motor Rating . . . . . The motor is continuously rated at 40 kw and provides a peak output of 67 kw at 8 m/s.
Type Power . . . . . 3-phase 415 v conductor rails through a half-controlled thryristor bridge
Power Collection . . . . . Power is drawn through a half-controlled thyristor bridge, which provides the entire traction control function.
Type Serive Brakes . . . . . A duplicated fail-safe brake system operates the inboard rear and outboard front brakes in conjunction with the motor braking.

SWITCHING:

Switching is provided by moving guide rails at a junction to form the guide slot in one or other route direction. Actuation and lock indication is given by a conventional railway point machine.

GUIDEWAY:

Type . . . . . Flat concrete bed with guidance trough and safety retaining walls at the sides of the running surface.
Materials . . . . . Concrete or steel
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 65.6 ft (20000 mm)
Overall Cross Section Width . . . . . 6.6 ft (2000 mm)

CONTROL:

Vehicles are controlled by a central computer, which is responsible for speed monitoring and control. A set of trackside equipment detects the passage of vehicles and relays the information to the central control system which monitors the vehicle headways. Speed control is performed by a closed loop speed control system which is also responsible for docking at stations.

STATIONS:

Data unavailable

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The responsibility for research and development has been undertaken by Transport and Road Research Laboratory (TRRL), in the United Kingdom, in association with Hawker Siddeley Dynamics Ltd. TRRL has provided assistance in assessing the effect of Minitram in different areas such as Westminster, London, Dockland and Birmingham, England.

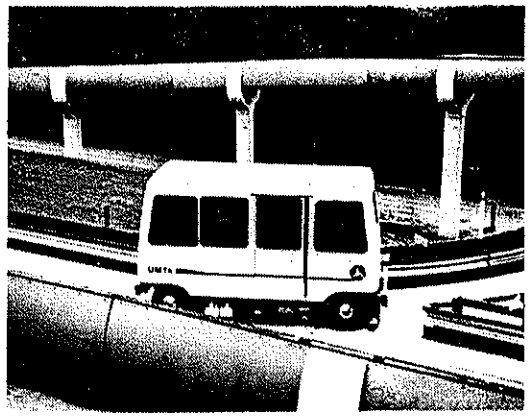
Presently, development is concentrated on the possibility of a public demonstration project in Sheffield, England during the early 1980's. The route tentatively chosen is about 2 km long and is intended to act as a city center distributor.

MORGANTOWN SYSTEM

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

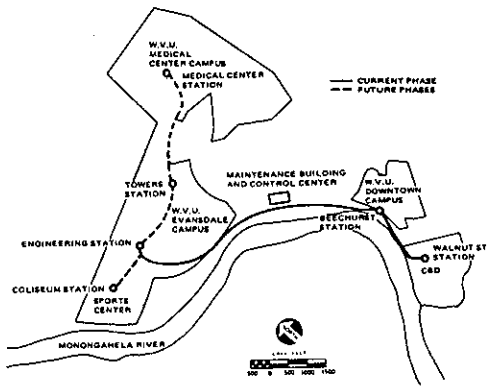
DEVELOPER: U.S. Department of Transportation
Urban Mass Transportation Administration
Office of Research & Development
Morgantown Division
2100 Second Street, S.W.
Washington, D.C. 20590
U.S.A.
Tel: (202) 426-4043



VEHICLE AT DIVERGE

ASSOCIATED DEVELOPERS:

Prime Contractor:	The Boeing Company P.O. Box 3999 Seattle, Washington 98124, U.S.A. Tel: (206) 773-3360
Command & Control Subcontract:	Bendix Corporation Ann Arbor, Michigan, U.S.A.
Power Collector & Vehicle Steering Mechanism:	Alden Self-Transit Systems Corporation Milford, Massachusetts U.S.A.
Software:	Systems Development Corporation Santa Monica, California, U.S.A.
Construction:	Frank Irey, Jr., Inc. Monongahela, Pennsylvania, U.S.A.
	Melbourne Bros. Construction Company North Canton, Ohio, U.S.A.
	The Trumbull Corporation Pittsburgh, Pennsylvania, U.S.A.
Electrical Installation:	Barnes & Brass Clarksburg, West Virginia, U.S.A.



NETWORK

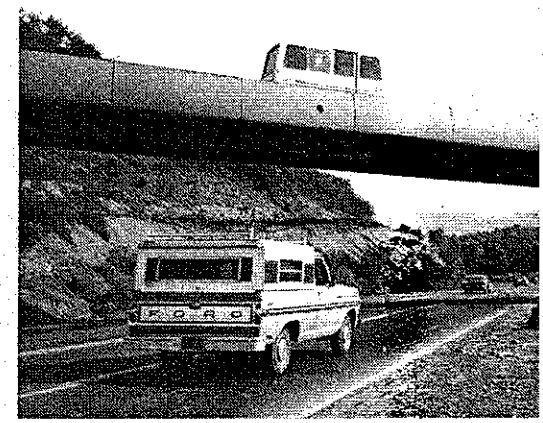
LICENSEES: None

PATENTS: None

DATA REFERENCE CODE: [a 51]

SYSTEM DESCRIPTION:

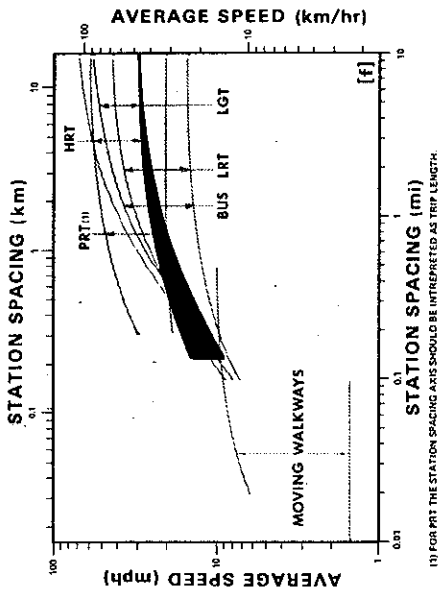
The Morgantown LGT system is a public demonstration project designed to connect the business of Morgantown, West Virginia, and the widely separated areas of the West Virginia University campuses. The system is totally automated and operates 15 driverless vehicles over 2.2 miles (3.54 km) of double guideways between three stations. The system operates in a scheduled mode during peak periods and on-demand for the off-peak periods. Plans call for a total of 45 vehicles. The maximum ride time between any two stations is approximately five minutes.

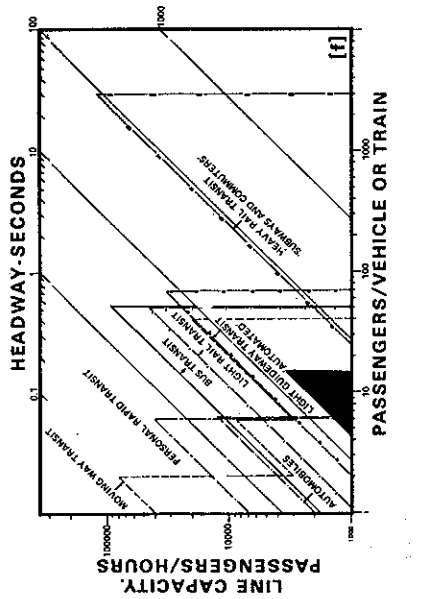


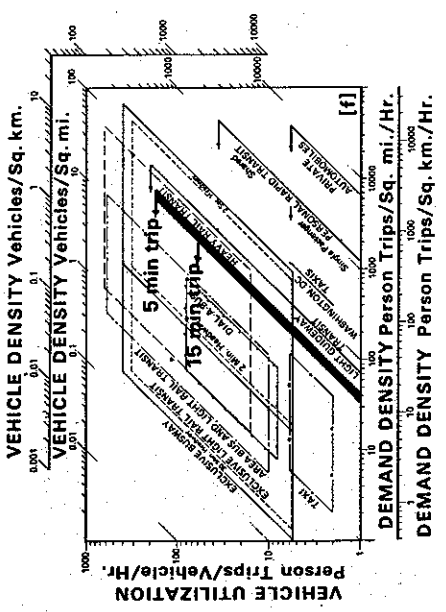
COMPLETED DOUBLE-GUIDEWAY CONFIGURATION

PUBLISHER'S NOTE:

Of the associated developers, Bendix and Alden Self-Transit each have other LGT systems in development. The Bendix and Alden systems are reported separately in this issue.







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . 5,040 psgr/hr
Max Practical One-Way Capacity . . . . . 3,500 psgr/hr
Min Theoretical Headway . . . . . 7.5 sec
Min Practical Headway . . . . . 15.0 sec
Availability . . . . . Scheduled and on-demand
Type Service . . . . . Point-to-point, limited collection & distribution
Type Network . . . . . Linear
Type of Vehicle Routing . . . . . Fixed
Traveling Unit . . . . . Single vehicles

VEHICLE PERFORMANCE:

Cruise Velocity . . . . . Up to 30.0 mph (48.0 km/h)
Max Velocity . . . . . 30.0 mph (48.0 km/h)
Max Grade 10%
Service Acceleration . . . . . 2.01 ft/s^2 (0.61 m/s^2)
Service Deceleration . . . . . 4.03 ft/s^2 (1.23 m/s^2)
Max Jerk . . . . . 3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel . . . . . 9.66 ft/s^2 (2.94 m/s^2)
Stopping Precision in Station . . . . . 6.0 in (152.4 mm)
Degradation if Guideway is Wet . . . . . Slight degradation in braking efficiency
Degradation for Ice & Snow . . . . . No degradation — guideway heating system provides for ice and snow
Vehicle Design Capacity . . . . . 8 seated 7 standing
Vehicle Crush Capacity . . . . . 8 seated 13 standing
Energy Consumption, Accelerating and Decelerating Only
  Empty Vehicle . . . . . Data unavailable
  At Design Capacity . . . . . Data unavailable
Energy Consumption
  Empty Vehicle . . . . . Data unavailable
  At Design Capacity . . . . . 0.64 kwh/veh-mi (0.398 kwh/veh-km)

STATIONS:

Type . . . . . End stations on-line, others off-line above grade
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic coin and card machines
Security . . . . . TV surveillance
Boarding Capacity . . . . . 1,680 psgr/hr per berth
Deboarding Capacity . . . . . 1,680 psgr/hr per berth
Max Wait Time . . . . . 5 min scheduled — 2 min on-demand
Vehicle in Station Dwell Time . . . . . 21 sec min, max 50 sec
Average Station Spacing . . . . . Approx 1.5 mi (2.41 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . Not necessary
Stops . . . . . Non-stop
Accommodation . . . . . Seated and standing
Comfort . . . . . Heated and air conditioned vehicles
Security . . . . . TV surveillance
Instruction . . . . . Signs, maps and active graphics

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Loss of vehicle hydraulics, loss of prime power, loss of communication with vehicle, failure to switch
Fail Operational Features . . . . . Motor overtemperature, computer failure, passenger service equipment, vehicle out of position trailing vehicle reaction
Total System Mean Time Before Failure . . . . . 26 hrs
System Restore Time After Failure . . . . . Max 1.0 hrs
Station Mean Time Before Failure . . . . . 78 hrs
Station Restore Time After Failure . . . . . Data unavailable
Vehicle Mean Time Before Failure . . . . . 54 hrs
Strategy For Removal of Failed Vehicle . . . . . Manual over-ride control of vehicle or towing of special recovery vehicle
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Provided through established emergency procedures, controlled by central operator, communication to each vehicle via on-board R.F. radio
System Lifetime . . . . . Data unavailable
Vehicle Lifetime . . . . . 10 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed) . . . . .
  Guideway . . . . . 6 months
  Station . . . . . Monthly
  Vehicle . . . . . 3,000 mi (4828 km)
Periodic Maintenance . . . . .
  Guideway . . . . . Yearly

Station . . . . . 6 months
Vehicle . . . . . 6,000 mi (9655 km)
Adjustments Required . . . . . Periodic adjustments to vehicle controls
Other Maintenance . . . . . .Maintenance facility includes storage yard, test track, and a vehicle and equipment service building

CARGO CAPABILITY:

Passenger Articles . . . . . .Small packages, luggage wheelchairs
Goods Movement . . . . . Loading and unloading facilities not provided

PERSONNEL REQUIREMENTS:

Typical System of 45 vehicles, 3 stations and 2.2 mi (3.54 km) of one-way guideway
No. of Operators/Vehicle . . . . . None
No. of Attendants/Station . . . . . None
No. of Administrative Personnel 4
No. of Central Control Attendants . . . . . 16/25032 hrs/yr
No. of Maintenance Personnel 21
Engineering Staff 2

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 15.5 ft (4.72 m)
Overall Width . . . . . 6.67 ft (2.03 m)
Overall Height . . . . . 8.75 ft (2.67 m)
Empty Weight . . . . . 8,600 lbs (3900 kg)
Gross Weight . . . . . 11,800 lbs (5352 kg)
Passenger Space (Design Load) . . . . . 16.0 ft^2 (1.47 m^2) seated
10.4 ft^2 (0.96 m^2) standing
Doorway Width . . . . . 38.0 in (966.2 mm)
Doorway Height . . . . . 72.96 in (1853.2 mm)
Step Height . . . . . .No steps

SUSPENSION:

Type . . . . . Rubber pneumatic tires and air bag suspension
Design Load . . . . . 5,900 lbs (2676 kg)/front suspension
5,900 lbs (2676 kg)/rear suspension
Lateral Guidance . . . . . .Double Ackerman actuated via closed loop steering control sensed by lateral wheels

PROPULSION & BRAKING:

Type & No. Motors . . . . . .Rotary dc motor with ac/dc converters on-board vehicle
Motor Placement . . . . . .One each per vehicle
Motor Rating . . . . . 70 HP, at 2,730 rpm
Type Drive . . . . . .Automobile-type differential
Gear Ratio 7.17:1
Type Power . . . . . 575 vac, 3ϕ, 400 amps max
Power Collection . . . . . Guideway power rails, two collector assemblies per vehicle
Type Service Brakes . . . . . .Dual friction, hydraulics redundant
Type Emergency Brakes . . . . . .Friction brakes
Emergency Brake Reaction Time . . . . . 0.2 sec

SWITCHING:

Type & Emplacement . . . . . .On-board vehicle via steering mechanism; active steering to either side of guideway
Switch Time (lock-to-lock) . . . . . 2 sec including verification
Speed Thru Switch . . . . . 22.5 mph (36.2 km/h) max
Headway Thru Switch . . . . . 15 sec min

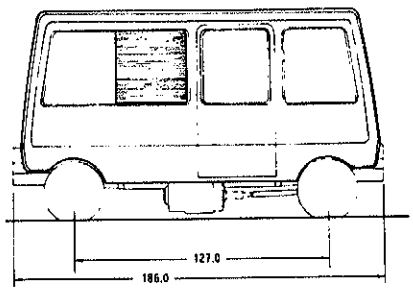
GUIDEWAY:

Type . . . . . U-shaped running surface with vertical sidewalls, 80% above grade, 20% at grade
Materials . . . . . .Reinforced concrete
Running Surface Width . . . . . 2.0 ft (609 mm) each wheel path on 5.17 ft (1576 mm) centers

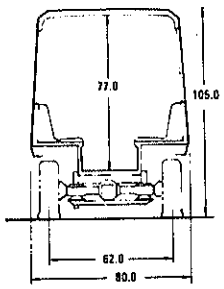
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 158 ft (48158.4 mm)
- Overall Cross Section Width . . . . . 12.6 ft (3840.5 mm)
- Overall Cross Section Height . . . . . 5.5 ft (1676.4 mm)
- Design Load . . . . . 840 lbs/ft (1249.64 kg/m)

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 158 ft (48158.4 mm)
- Overall Cross Section Width . . . . . 22.4 ft (6827.5 mm)
- Overall Cross Section Height . . . . . 5.5 ft (1676.4 mm)
- Design Load . . . . . 1,680 lbs/ft (761.9 kg/m)

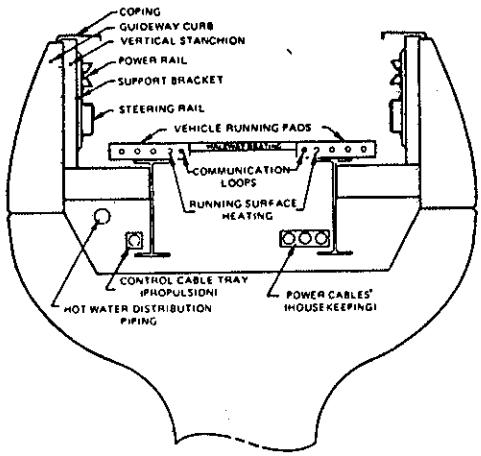
Guideway Passenger Emergency Egress . . . . . .Vehicle rear window and side door, emergency walkways
Type Elevated Guideway Support Columns . . . . . I-beams



DIMENSIONS IN INCHES

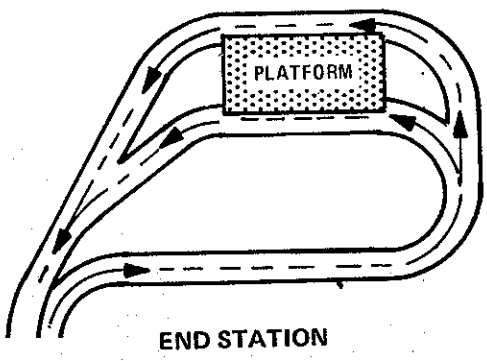


VEHICLE DIMENSIONS

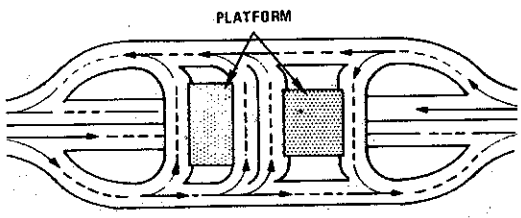


NOTE
THE CROSS SECTION SHOWN IS AT A TRANSITION POINT WHERE DUPLICATE POWER AND STEERING RAILS ARE PROVIDED (MERGE AND EMERGE POINTS)

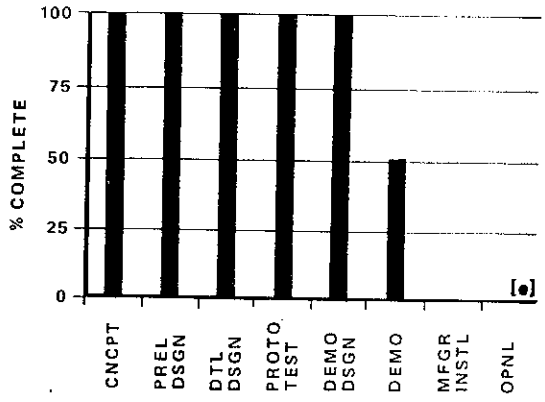
GUIDEWAY CROSS-SECTION



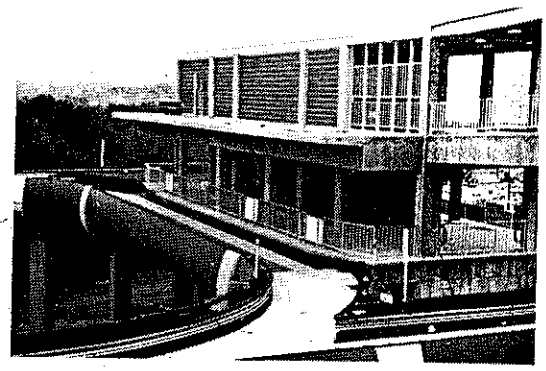
END STATION



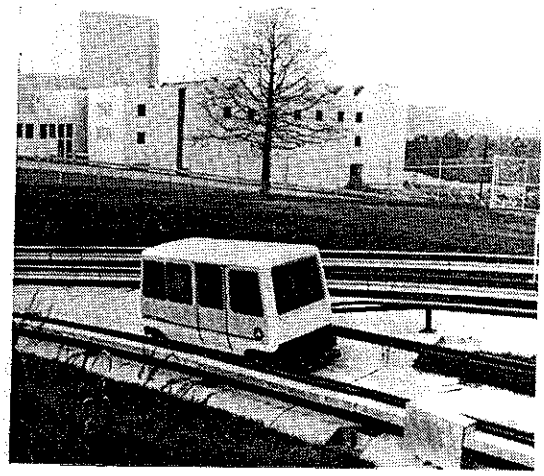
THROUGH STATION



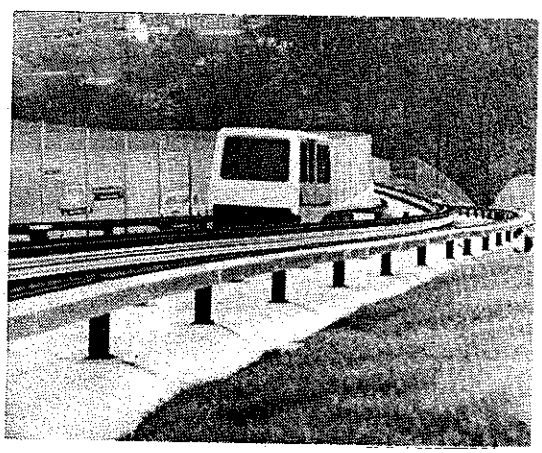
DEVELOPMENT STATUS



ENGINEERING STATION



VEHICLE ON AT-GRADE DIVERGE



VEHICLE ON AT-GRADE SECTION

CONTROL:

Synchronous automatic, 3-level hierarchy control system; central computer provides total supervision and management, processes demands, establishes moving slots, routes, schedules, vehicle dispatch, and manual operator subroutines for start-up, shut down, and degraded performance. Station computer controls station and given guideway length, slot assignments, slot monitoring, commands switching, station stopping, and door operation. Vehicle computer contains velocity, position, and stopping profiles, door controller, velocity and position processor and control. Headway control via in-vehicle point-follower with totally separate fixed block collision avoidance.

STATIONS:

On-Line End Station — Incoming vehicles have access to either side. All guideway is at the same level with platform access from below. Each loading platform accommodates 100 persons.

Off-Line Through Station — Main guideway depressed under loading area; station guideways are elevated above main line. Two platforms are provided, 4 loading/unloading lanes, and loading platform can accommodate 100 to 300 persons each. Passenger access is from upper level.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The project is a multiphase program to design, develop, test, and demonstrate through revenue service. It began as a West Virginia University (WVU) research study under an UMTA grant in 1969. The program has proceeded to current Phase 1A, wherein a system of 3 stations, 5 vehicles, 5.5 mi (8.85 km) total length of one-way guideway [including 0.7 mi (1.13 km) in maintenance facility] has been constructed and extensive test and evaluation completed. Phase 1A was completed on June 30, 1973, at a total cost of $40 million.

Phase 1B will expand the system (including 40 additional vehicles, plus additional command and control, fare collection, software, maintenance, guideway heating, etc. items) to place the system in revenue service. Allocations for Phase 1B are $20.4 million.

If fully expanded, through other phases, the system would serve a 3.6 mile corridor with as many as 100 vehicles operating at minimum headways of 15 seconds.

Editor understands that controvery between UMTA and WVU has been resolved and that the 2.2 mi (3.54 km) system will be completed [e].

COSTS:

Capital . . . . . Vehicle — $150,000 each
Station — $400,000-$1,000,000 each
Guideway — $22 million/mi ($13.7 million/km)/double guideway including electrification
Command & Control — $3.5 million
Operation & Maintenance . . . . . 30 cents/veh-mi (18.6 cents/veh-km) per WVU demand table

INSTALLATIONS OR RETROFIT CAPABILITY:

Double Lane Guideway Envelope Width	22.4 ft (6.83 m)
Guideway & Vehicle Envelope Height	12.0 ft (3.66 m)
Single Lane Guideway Structural Weight	259 lbs/ft (386 kg/m)
Double Lane Guideway Structural Weight	518 lbs/ft (772 kg/m)
Max Grade	10%
Min Vertical Turn Radius	60 ft (18.3 m) at 30 mph (48.3 km/h)
Min Horizontal Turn Radius	30.0 ft (9.14 m) at 6.0 mph (9.7 km/h)
Construction Process	On-site fabrication of guideways and stations
Staging Capability	Sections can be completed and put in service while others are under construction.

LIMITATIONS:

Overall size of vehicle and guideway may limit retrofit installations to uncrowded sites unless major modifications made to surrounding structures. Permitting standees limits normal service accel/decel to approx 4.4 ft/sec^2 (1.34 m/sec^2). [e]

Adaptation to headways less than 7.5 sec requires modifications. [e]

Climate Limits — +120 F^o to -30 F^o temperature; 1 in/hr rain, 10 in/day snow, 100% humidity, 30 mph wind, 60 mph gust.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No appreciable direct emissions
Visual, Single Lane Elevated Guideway . . . . . .
H_1 — 5.5 ft (1.68 m), H_2 — approx 12.0 ft (3.66 m)
W_1 — 12.6 ft (3.84 m), W_2 — 12.6 ft (3.84 m)
P_1 — approx 12.8 ft (3.9 m), P_2 — 14.3 ft (4.36 m)
Noise . . . . . 65 dbA (or NCA 60) inside vehicle
NCA 60 at 25 ft (7.62 m) above
NCA 60 at 25 ft (7.62 m) below
NCA 60 at 25 ft (7.62 m) to side

NTS (Newtran System)

CLASSIFICATION: Light Guideway Transit

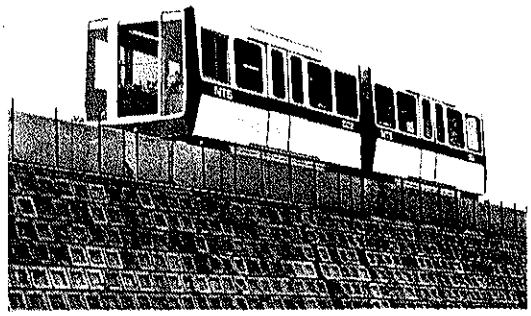
OTHER NAMES: None

DEVELOPER: Niigata Engineering Co., Ltd.
Ground Transportation System Group
Project Planning and Development Division
4-1 Kasumigaseki; 1-chome
Chiyoda-ku, Tokyo, Japan
Tel: Tokyo (03) 504-2111

LICENSEES: None

PATENTS: Information unavailable

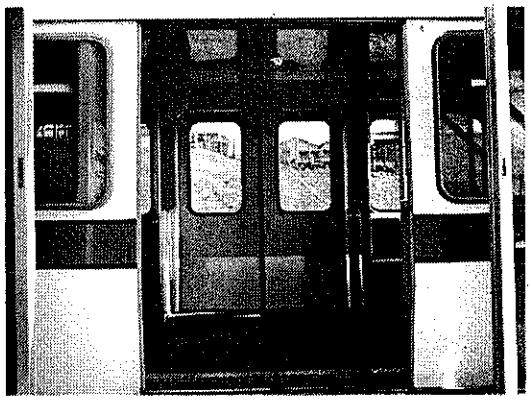
DATA REFERENCE CODE: [a 21]



VEHICLE ON ELEVATED GUIDEWAY

SYSTEM DESCRIPTION:

NTS is a completely automated system capable of transporting both passengers or cargo by container, pallet, etc. The main emphasis of the system design is to minimize pollutant emission, material waste, labor requirements, capital and operational costs. The system components are selected by placing emphasis on the safety of the unmanned automatic operation. The small size of the vehicles permits adaptibility to various urban spaces. The loop and line-haul can be adopted by scheduled, floating or on-demand routing. The system can operate with single vehicles or 2-6 car trains and if necessary, automatic coupling/decoupling can be arranged for the vehicles. The guideway is of U-shaped construction with a refuge line for emergency, and a simple, quick and accurate switching device. An automobile system is employed for both the steering and running device, possibly lending adaptibility to a dual-mode system.



VEHICLE INTERIOR VIEW THRU STATION DOORS

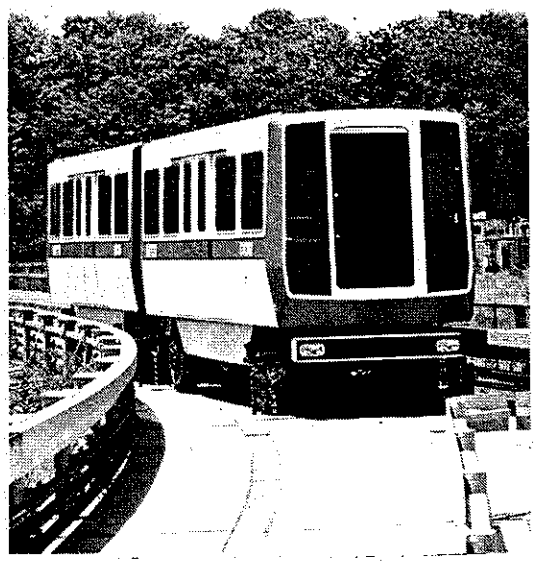
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	22,500 psgr/hr
Max Practical One-Way Capacity	20,000 psgr/hr
Min Theoretical Headway	25 sec
Min Practical Headway	70-90 sec
Availability	Scheduled or on-demand
Type Service	Limited area collection/distribution
Type Network	Line-haul, shuttle or loops
Type of Vehicle Routing	Fixed or variable
Traveling Unit	Single vehicle or 2-6 car trains

VEHICLE PERFORMANCE:

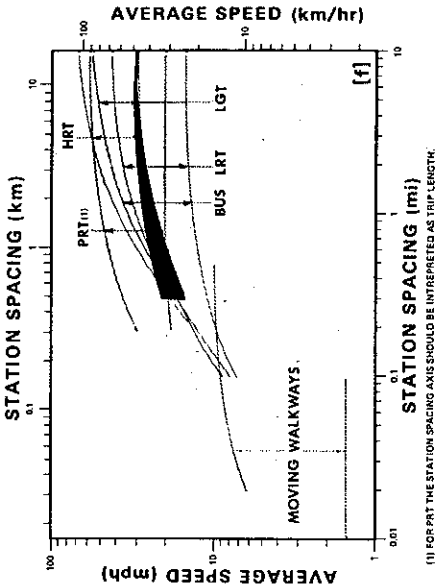
Cruise Velocity	31 mph (50 km/h)
Max Velocity	37.2 mph (60 km/h)
Max Grade	7-10%
Service Acceleration	3.2 ft/s^2 (0.97 m/s^2)
Service Deceleration	3.2 ft/s^2 (0.97 m/s^2)
Max Jerk	2.7 ft/s^3 (0.83 m/s^3)
Emergency Decel	4.6 ft/s^2 (1.39 m/s^2)
Stopping Precision in Station	±11.7 in (±300 mm)

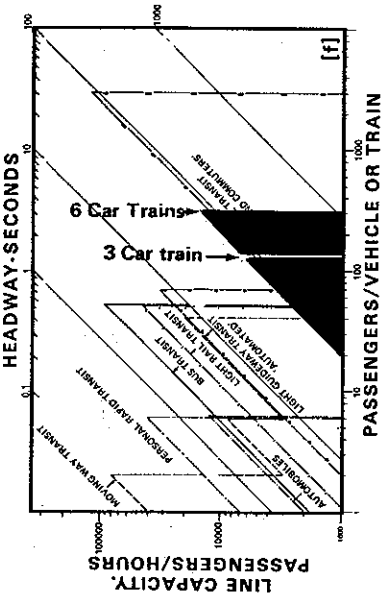


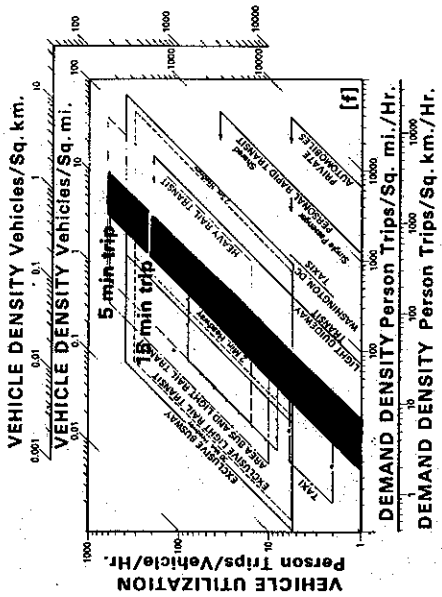
DIVERGE/CONVERGE ON TEST TRACK

PUBLISHER'S NOTE:

The NTS system is similar to the AIRTRANS system. It is built under License from LTV (See AIRTRANS report, this issue).







Degradation if Guideway is Wet . . . . . .No degradation
Degradation for Ice & Snow . . . . . Data unavailable
Vehicle Design Capacity . . . . . 24 seated 26 standing
Vehicle Crush Capacity . . . . . 24 seated 51 standing
Energy Consumption, Accelerating and Decelerating Only
Empty Vehicle . . . . . 3.7 kwh/veh-mi (2.3 kwh/veh-km)
At Design Capacity . . . . . 5.9 kwh/veh-mi (3.7 kwh/veh-km)
Energy Consumption, Cruise Only
Empty Vehicle . . . . . 0.79 kwh/veh-mi (0.49 kwh/veh-km)
At Design Capacity . . . . . 1.28 kwh/veh-mi (0.8 kwh/veh-km)

STATIONS:

Type . . . . . .On-line (off-line possible)
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic machine
Security . . . . . Public address system, closed circuit TV and synchronized platform door
Boarding Capacity . . . . . approx 7,200 psgr/hr/berth [e]
Deboarding Capacity . . . . . approx 7,200 psgr/hr/berth [e]
Max Wait Time . . . . . 70 - 90 sec
Vehicle in Station Dwell Time . . . . . Approx 20 sec
Average Station Spacing . . . . . 0.25 - 0.60 mi (0.4 - 1.0 km)

INDIVIDUAL SERVICE:

Privacy . . . . . .Passengers share vehicles.
Transfers . . . . . .As required
Stops . . . . . Vehicle stops for other passengers or non-stop service.
Accommodation . . . . . .Seated and standing
Comfort . . . . . .Heated and air conditioned vehicles
Security . . . . . Central voice communication, emergency stop button in vehicles
Instruction . . . . . .Signs, route maps, automated graphics and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . . . .Monitoring of operation conditions is done by self check and mutual check computer systems. The emergency stop function ATC device and the backup system for the train detection device are fail safe features.
Fail Operational Features . . . . . Computer backup system is provided and may be operated manually.
Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Data unavailable
Strategy For Removal of Failed Vehicle . . . . . .Vehicle pushed to storage by successor vehicle
Strategy For Passenger Evacuation of Failed Vehicle . . . . . .Passengers exit by front or rear doors to guideway where rescue vehicle picks up passengers.
System Lifetime . . . . . Data unavailable
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Data unavailable
Other Maintenance . . . . . Special automatic inspection system

CARGO CAPABILITY:

Passenger Articles . . . . . Small articles, luggage and wheelchairs
Goods Movement . . . . . Special freight vehicles

PERSONNEL REQUIREMENTS:

Typical System of 100 vehicles, 20 stations and 12.4 mi (20 km) of one-way guideway
No. of Operators/Vehicle 0
No. of Attendants/Station 0
No. of Administrative Personnel 4
No. of Central Control Attendants . . . . . 2/6 hrs
No. of Maintenance Personnel 20
Engineering Staff 12

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 24.6 ft (7500 mm)
Overall Width . . . . . 7.48 ft (2280 mm)
Overall Height . . . . . 10.0 ft (3050 mm)
Empty Weight . . . . . Approx 15,435 lbs (7000 kg)
Gross Weight . . . . . Approx 24,696 lbs (11200 kg)
Passenger Space (Design Load) . . . . . 3.98 ft^2 (0.37 m^2) seated
2.05 ft^2 (0.19 m^2) standing
Doorway Width . . . . . 51.2 in (1300 mm)
Doorway Height . . . . . 70.9 in (1800 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . 4 foam-filled rubber tires, air bag suspension
Design Load . . . . . 12,348 lbs (5600 kg)/front suspension
12,348 lbs (5600 kg)/rear suspension
Lateral Guidance . . . . . Double Ackerman actuated by
4 lateral guidewheels

PROPULSION & BRAKING:

Type & No. Motors . . . . . 1 dc shunt motor per vehicle,
rated voltage: 270 vdc
Motor Placement . . . . . On board vehicle, under floor
Motor Rating . . . . . 95 HP, 70 kw at 1350 rpm
Type Drive . . . . . Right angled Cardan type and differential gear
Gear Ratio 1:6.833
Type Power . . . . . 400/400 vac, 3ϕ, 600 max amps
Power Collection . . . . . 3ϕ side rail
Type Service Brakes . . . . . Regenerative electric brake and
air brakes
Type Emergency Brakes . . . . . Air actuated friction brake,
spring action brake
Emergency Brake Reaction Time . . . . . less than 1 sec

SWITCHING:

Type & Emplacement . . . . . Mechanical, switch blade on parapet
entraps vehicle guidewheels
Switch Time (lock-to-lock) . . . . . 3 sec
Speed Thru Switch . . . . . 21.7 mph (35 km/h) max
Headway Thru Switch . . . . . 25 sec min

GUIDEWAY:

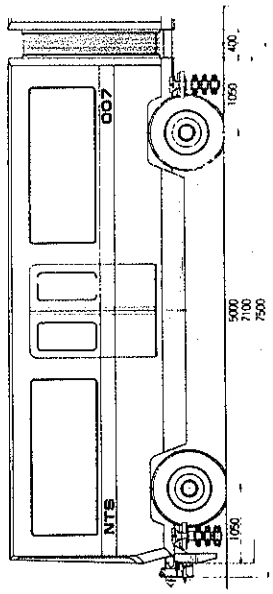
Type . . . . . U-shaped roadway at, above, or below grade
Materials . . . . . Prestressed concrete or steel
Running Surface Width . . . . . 7.38 ft (2550 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 65.6 ft (20 m)
Overall Cross Section Width . . . . . 9.35 ft (2850 mm)
Overall Cross Section Height . . . . . 4.59 ft (1400 mm)
Design Load . . . . . 1075 lbs/ft (1600 kg/m)
Double Lane Elevated Guideway:
Max Elevated Span . . . . . 65.6 ft (20 m)
Overall Cross Section Width . . . . . 18.73 ft (5710 mm)
Overall Cross Section Height . . . . . 4.67 ft (1400 mm)
Design Load . . . . . 1075 lbs/ft (1600 kg/m)
Guideway Passenger Emergency Egress . . . . . Front, rear or side doors
Type Elevated Guideway Support Columns . . . . . Reinforced concrete or
steel T-shaped

CONTROL:

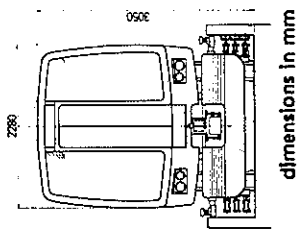
The Control System consists of three fundamental systems:

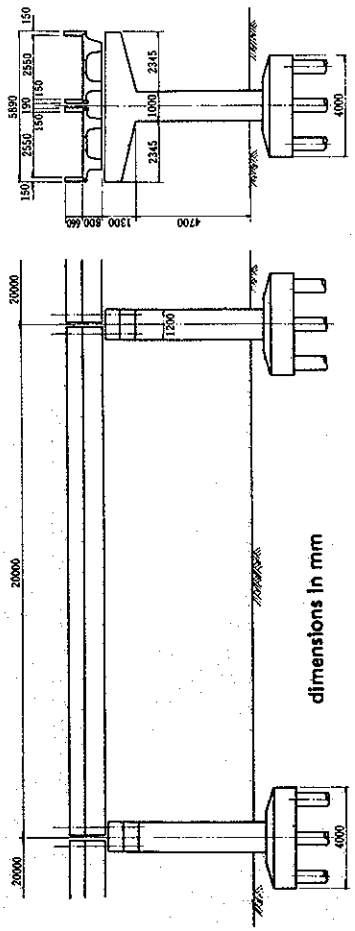
1. System consisting of a centralized control unit by a computer control system.
2. ACT device of decentralized control type for back-up.
3. Manned supervisory control system between each terminal and central operator such as ITV, between central office, stations and vehicles, telephone devices, and information broadcasting device.

The computer control system is a load share system in which the control of respective vehicles such as the fixed speed control, fixed position stop, etc., is processed by a micro-processor on the vehicles, and the matters that should be judged from the entire system such as mutual interval of the train groups, schedule, guideway conditions, and handling of emergency cases, etc., are processed by the central computer.

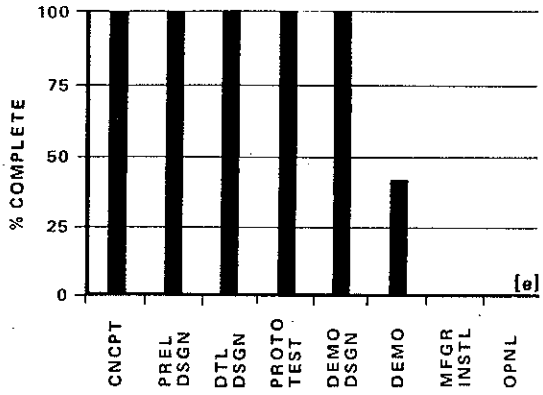


VEHICLE DIMENSIONS

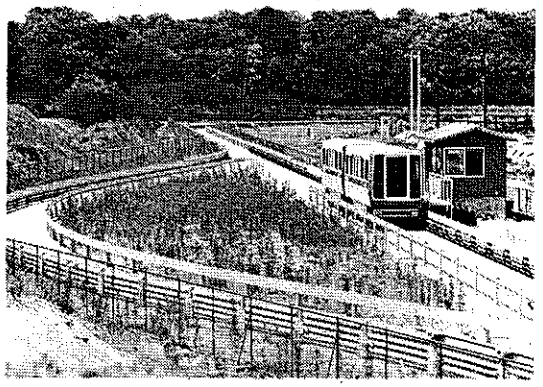




ELEVATED GUIDEWAY DIMENSIONS



DEVELOPMENT STATUS



The central computer is composed of, in tier form, a parallel double computer adapted for operational control such as speed instructions and assigned to perform the communication control with each terminal such as vehicles, stations, and switching devices, and an upper computer adapted for operational optimizing control for the conversation with the central operator as its primary function.

Communication with the vehicles is carried out by the twisted pairs inductive radio system, which is unique in that the vehicle position is detected as an absolute address by signals transmitted from the system mounted in the vehicle.

In case of computer system failure, a fail safe feature such as time-out check of the communication is provided, and safety is assured by the ATC. The construction of the vehicle permits manual operations.

STATIONS:

Particular attention is paid to safety at the station due to unmanned operation. The station doors, provided for the platform side, are interlocked with the opening/closing of the vehicle doors. The station itself is closed to the guideway except for the time when the vehicles stop at the platform.

The unmanned station is equipped with an information display device, information broadcasting device to secure the service level for passengers, as well as interphones for conversation with the central operator, and ITV cameras for monitoring conditions of the station. Space heating and cooling features, elevators and escalators are installed according to requirements. An automatic ticket examination system is introduced for the unmanned station with information relating to the flow of passengers constantly transmitted to the computer. Data is reflected in the flexible operation program making on-demand operation possible.

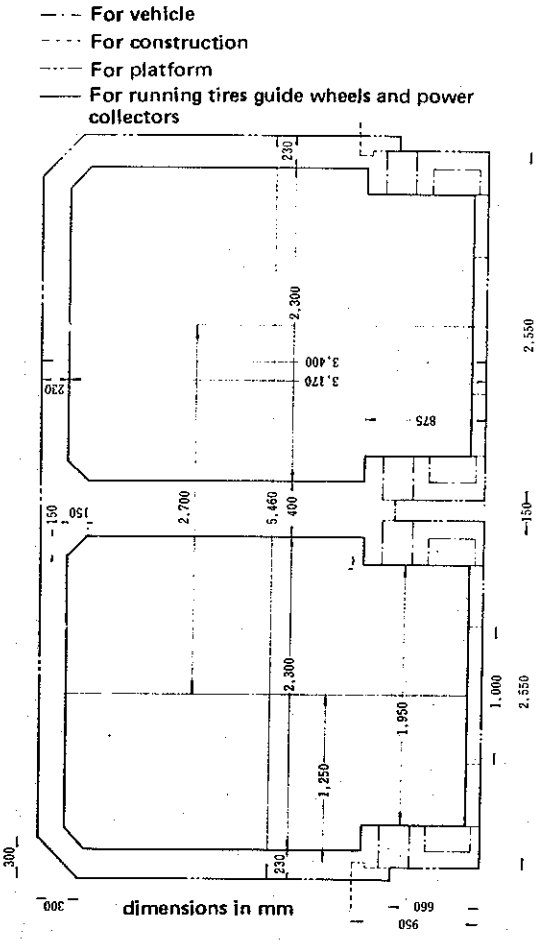
Safety conditions such as the operation of each piece of equipment, fire, etc., are transmitted to the central station from each station as one unit and are monitored. The automatic equipment is arranged so that it may be switched to manual operation.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

1969 — Development started
1972 — Full scale prototype design completed
1973 — Licensed with LTV (USA)
1973-74 — Operation and component testing
1975 — Commercial demonstration

INSTALLATIONS & CONTRACTS:

Full scale prototype test facility 0.4 mile (650 m) long, 7% grade and 3 switchings. Test vehicles are 4 cars (2 cars/unit), one station, full automatic operation. Test facility is located at Oyama Works of Niigata Engineering Co., Ltd., in Niigata City.



INSTALLATION ENVELOPE

COSTS:

(Based upon typical system of 12.4 mi (20 km) single lane guideway, 20 stations, 100 vehicles, 100 veh-mi/day, 5 veh-hr/day, 20 hrs operation per day)

Capital Cost . . . . . otal avg of $5,280,000/mi ($3,300,000/km) single lane
Avg Cost per Single Lane Guideway $1,680,000/mi ($1,050,000/km)
Avg Cost per Station $300,000
Avg Cost per Vehicle $120,000
Computers, Software, & Control Center $15,000,000
Maintenance & Storage Facilities $3,000,000
Power Distribution & Substations $9,000,000
Operation & Maintenance Costs . . . . . Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 9.06 ft (2760 mm)
Single Lane Guideway Envelope Height . . . . . 11.16 ft (3400 mm)
Single Lane Guideway Structural Weight . . . . . 1935 lbs/ft (2880 kg/m)
Double Lane Guideway Structural Weight . . . . . 3871 lbs/ft (5760 kg/m)
Max Grade 7-10%
Min Vertical Turn Radius . . . . . 3,333 ft (1000 m) at 31.25 mph (50 km/h)
Min Horizontal Turn Radius . . . . . 65.6 ft (20 m) at 3.1 mph (5 km/h)
Construction Process . . . . . Precast beams for elevated guideway, other sections poured in place
Staging Capability . . . . . Sections can be operated while others under construction

LIMITATIONS: [e]

On-line stations would limit headway to 60 to 90 sec.
Standing passengers will limit accel/decel to approx 4.4 ft/s^2 (1.34 m/s^2).

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . .
H_1 — 2.82 ft (860 mm), H_2 — 10.66 ft (3250 mm)
W_1 — 9.35 ft (2850 mm), W_2 — 9.35 ft (2850 mm)
P_1 — 8.61 ft (2623 mm), P_2 — 14.15 ft (4313 mm)
Noise . . . . . Design goal of 60 dbA at 25 ft (7.5 m) to side

OKINAWA KRT
(Kobe Personal Rapid Transit) SYSTEM

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

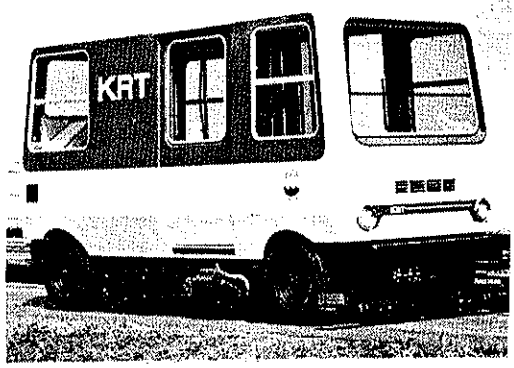
DEVELOPER: Kobe Steel, Ltd.
PRT Promotion Dept.
Machinery Division
Tokyo Head Office
Tekko Building 8-2, 1-chome
Marunouchi, Chiyoda-ku
Tokyo, Japan
Tel: Tokyo (03) 218-7486

Nissho-Iwai
Environment Control Machinery Dept.
Nissho-Iwai Building
4-5, Akesaka 2-chome
Mineto-ku
Tokyo 107, Japan
Tel: Tokyo (03) 588-2111

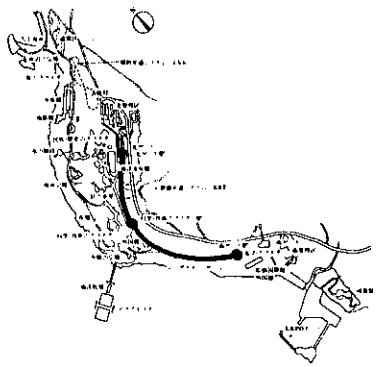
LICENSEES: None

PATENTS: None

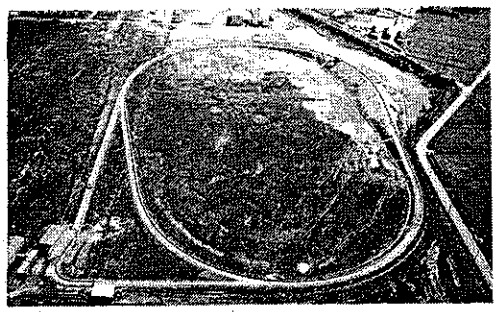
DATA REFERENCE CODE: [a 61]



TYPICAL VEHICLE FOR THE OKINAWA EXPOSITION



TEST TRACK AT SHINKO ELECTRIC CO., TOYOHASHI, JAPAN



DEMONSTRATION INSTALLATION AT THE OKINAWA EXPOSITION

SYSTEM DESCRIPTION:

The KRT System is automated, computer controlled and equipped with small vehicles. The design is based on the Morgantown System. A test track is located in Tooyohashi at the Skinko Electric Co. Facilities with a guideway length of 0.58 mi (0.932 km), one off-line station with one channel and two berths, control center, power sub-station and two vehicles. The control is fully automated and computer controlled and operates with a minimum headway of 15 sec and has a min radius of 30.0 ft (9.14 m) and max grade of 8%.

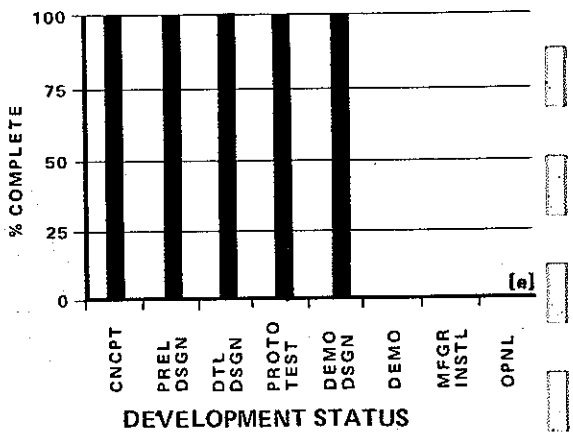
The KRT System was adopted as the main transport system for the International Ocean Exposition of Okinawa (IOEO) July, 1975. This will be the first operational LGT transport system in Japan. The total guideway length is 2.3 mi (3.7 km) and the system has three off-line stations. The operation is fully automated and computer controlled, has a minimum headway of 15 sec and maximum speed of 28.9 mph (48 km/h) and sixteen vehicles with a maximum capacity of 33 passengers/veh. The normal capacity is 25, 10 seated and 15 standing.

The KRT System can be used at airports to connect terminal buildings, in recreation areas, shopping centers and for service between stations of other transit systems.

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

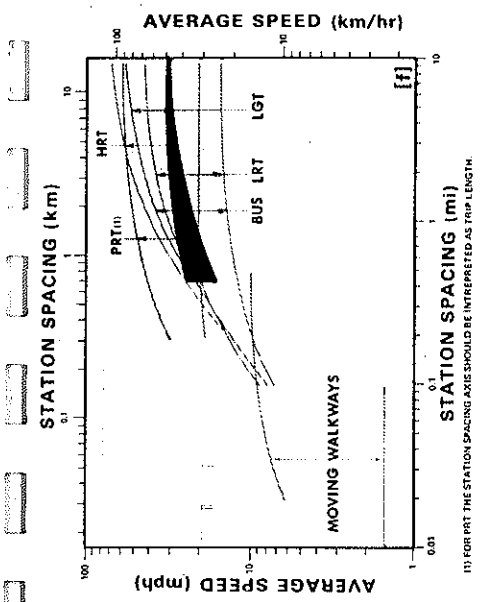
Max Theoretical One-Way Capacity	10,000 psgr/hr
Max Practical One-Way Capacity	6,000 psgr/hr
Min Theoretical Headway	9 sec
Min Practical Headway	15 sec
Availability	Scheduled and on-demand
Type Service	Point-to-point
Type Network	Linear
Type of Vehicle Routing	Fixed
Traveling Unit	Single vehicles



DEVELOPMENT STATUS

PUBLISHER'S NOTE:

Since the design and the performance of the system is very similar to the Morgantown System, additional data and information can be taken from the Morgantown report (this issue).



VEHICLE PERFORMANCE:

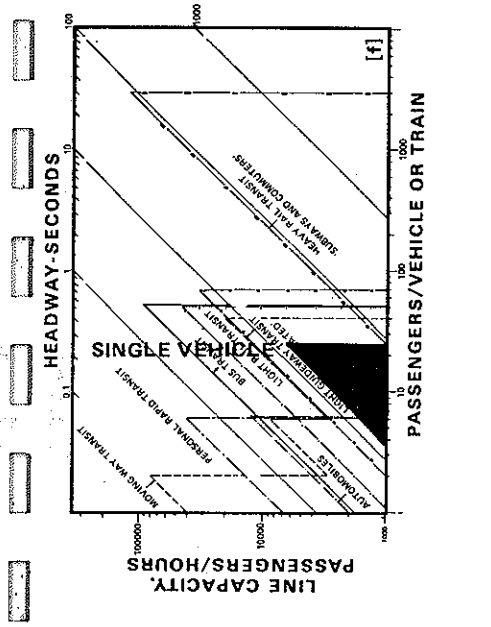
Cruise Velocity	Up to 31.1 mph (50.0 km/h)
Max Velocity	31.1 mph (50.0 km/h)
Max Grade	10%
Service Acceleration	2.0-4.0 ft/s^2 (0.6-1.2 m/s^2)
Service Deceleration	2.0-4.0 ft/s^2 (0.6-1.2 m/s^2)
Max Jerk	3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel	9.66 ft/s^2 (2.94 m/s^2) [e]
Stopping Precision in Station	5.9 in (150 mm)
Degradation if Guideway is Wet	Slight degradation in braking efficiency [e]
Degradation for Ice & Snow	Data unavailable
Vehicle Design Capacity	10 seated 15 standing
Vehicle Crush Capacity	10 seated 23 standing

STATIONS:

Type	3 off-line
Type Boarding	Level

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles
Transfers	Not necessary
Stops	Non-stop
Accommodation	Seated and standing



PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	15.5 ft (4724 mm)
Overall Width	6.7 ft (2032 mm)
Overall Height	8.8 ft (2667 mm)
Empty Weight	9,041 lbs (4100 kg)
Gross Weight	14,498 lbs (6575 kg) [f]

SUSPENSION:

Type	Air and 2 chamber rubber tires
Lateral Guidance	Side steering, four wheels

PROPULSION & BRAKING:

Type & No. Motors	One dc motor per vehicle
Motor Placement	On-board
Motor Rating	55 kw
Type Power	600 vac, 3 phase
Power Collection	Dual side power rails, one on each side of guideway
Type Service Brakes	Dual, hydraulics redundant

SWITCHING:

Type & Emplacement	On board vehicle via steering mechanism

CONTROL:

The operation is fully automated and under computer control. The control center is equipped with control and communication devices such as computer, data handling unit, CRT display, vehicle operator display panel, and power supply panel which controls the vehicles on the guideway, starting and stopping at the stations, collision avoidance system, and monitors the overall system including the power sub-system control.

In addition to the automatic control, operators monitor all function on the control console to assure dual safety. The vehicle is equipped with four wheel side steering and a vehicle communication and control system (VCCS).

STATIONS:

Stations are off-line with one channel and two berths, thus allowing two vehicles at a time. Vehicles in the station area are directly grounded to assure passenger safety.

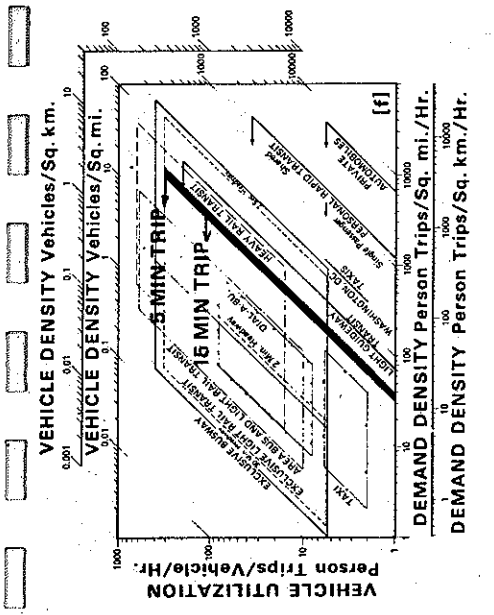
DEVELOPMENT HISTORY, PLANS & PROGRESS:

The design is based on the Morgantown system. Before implementation of the KRT System a test track facility was completed. Based on the current prototype the company will continue research and development work on variations of the system to meet diversified needs in the future.

INSTALLATIONS & CONTRACTS:

Test track at Shinko Electric Co., Toyohashi, Japan

Demonstation system at the International Ocean Exposition of Okinawa, Japan.



PARATRAN SYSTEM (Public and Automated Rapid Transportation System)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: Paratoran-Shisutemu

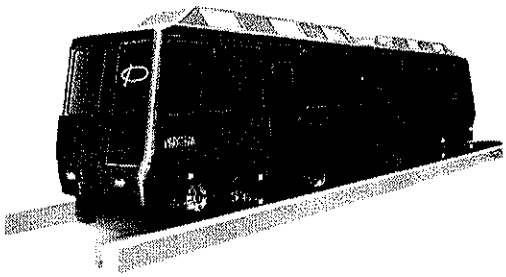
DEVELOPERS: Hitachi, Ltd.
6-2, 2-chome, Ohtemachi
Chiyoda-ku, Tokyo, Japan
Tel: Tokyo 270-2111

Tokyu Car Corporation
1 Kamariyacho, Kanazawa-ku
Yokohama, Japan
Tel: Yokohama 701-5151

LICENSEES: None

PATENTS: Patents pending

DATA REFERENCE CODE: [a 21]



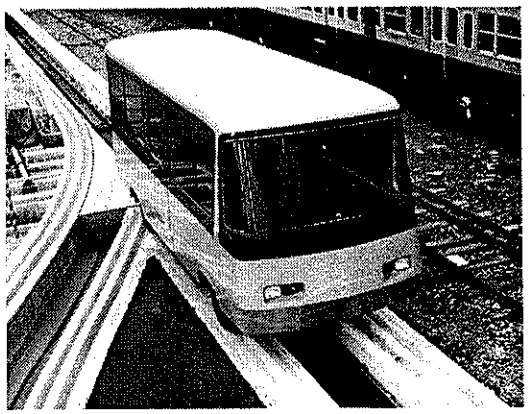
PARATRAN II

SYSTEM DESCRIPTION:

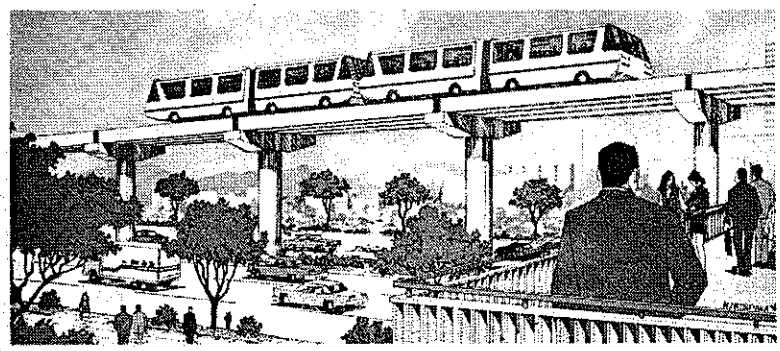
The PARATRAN System is a totally automated medium capacity system for transporting passengers along a line or around loops for point-to-point or collection and distribution service. The developer proposes that the system be applied in new towns or in major activity centers as a circulator.

The vehicles are rubber-tired and operated as pairs linked into trains running over an exclusive guideway. The number of vehicles per trains is controlled as a function of demand rate.

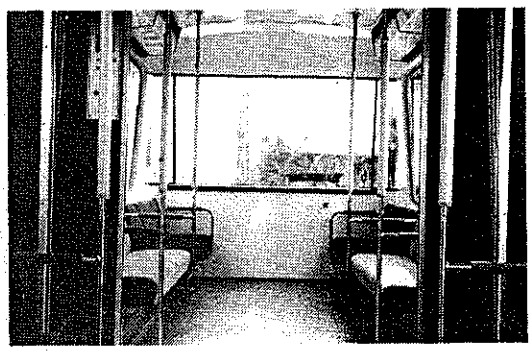
The development of PARATRAN II began in 1974, the sytem is similar to the design of original PARATRAN I system, the exceptions being the vehicle and guideway design.



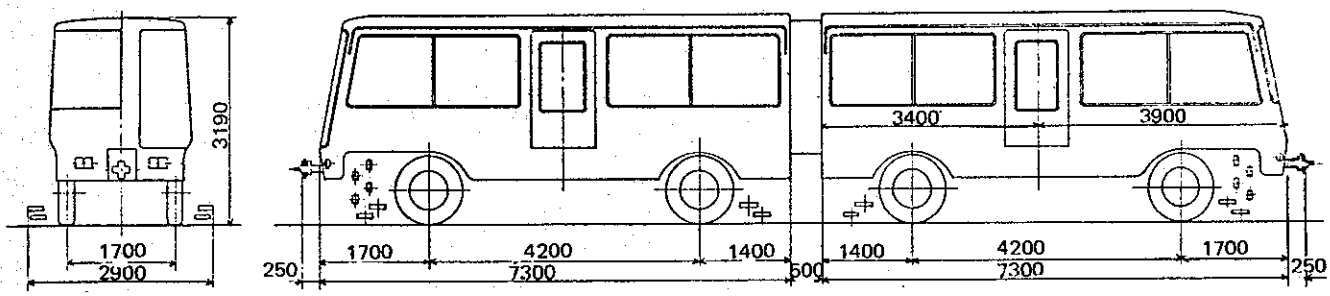
PARATRAN I
PROTOTYPE VEHICLE



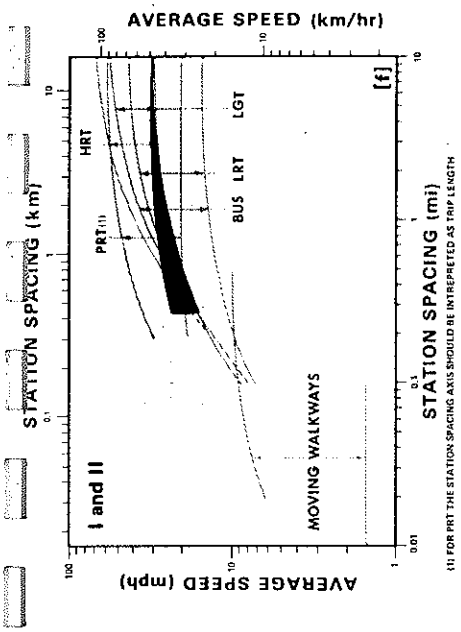
PARATRAN I

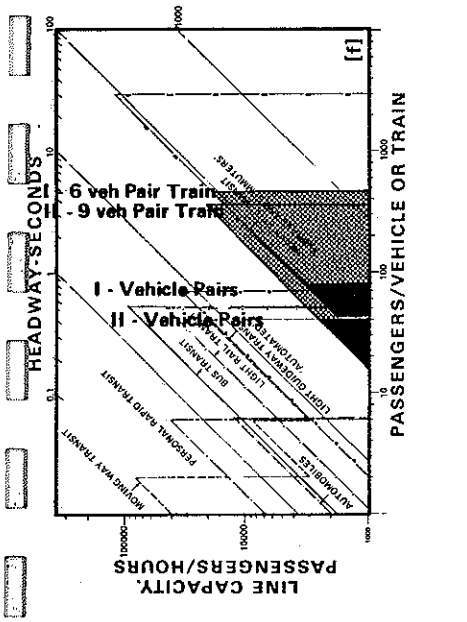


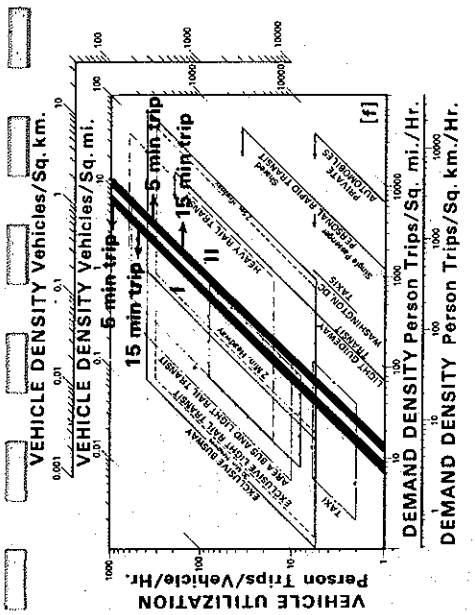
PARATRAN I PROTOTYPE
VEHICLE INTERIOR



PARATRAN I – VEHICLE DIMENSIONS







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . I[1] - 19,200 psgr/hr
II[2] - 20,000 psgr/hr
Max Practical One-Way Capacity . . . . . I - 19,200 psgr/hr
II - 20,000 psgr/hr
Min Theoretical Headway . . . . . I - 90 sec, II - 60 sec
Min Practical Headway . . . . . I - 90 sec, II - 60 sec
Availability . . . . . Fixed or floating schedule and on-demand
Type Service . . . . . Limited area point-to-point, limited area collection/distribution
Type Network . . . . . Loop or line-haul
Type of Vehicle Routing . . . . . Fixed
Traveling Unit . . . . . Trains of permanently paired vehicles

VEHICLE PERFORMANCE: (2 car unit)[3]

Cruise Velocity . . . . . I - 30 mph (I - 48 km/h)
II - 31 mph (II - 50 km/h)
Max Velocity . . . . . I - 37 mph (I - 60 km/h)
II - 37 mph (II - 60 km/h)
Max Grade 7%
Service Acceleration . . . . . 3.19 ft/s^2 (0.97 m/s^2)
Service Deceleration . . . . . 4.1 ft/s^2 (1.25 m/s^2)
Max Jerk . . . . . 3.22 ft/s^3 (0.98 m/s^3)
Emergency Decel . . . . . 9.65 ft/s^2 (2.94 m/s^2)
Stopping Precision in Station . . . . . ±11.8 in (±300 mm)
Degradation if Guideway is Wet . . . . . None
Degradation for Ice & Snow . . . . . None
Vehicle Design Capacity . . . . . I - 44 seated I - 36 standing
II - 19 seated II - 21 standing
Vehicle Crush Capacity . . . . . I - 44 seated I - 76 standing
II - 19 seated II - 41 standing
Energy Consumption, Accelerating and Decelerating Only
Empty Vehicle . . . . . 0.9 kwh/veh-mi (0.6 kwh/veh-km)
At Design Capacity . . . . . 1.2 kwh/veh-mi (0.7 kwh/veh-km)
Energy Consumption, Cruise Only
Empty Vehicle . . . . . 0.57 kwh/veh-mi (0.36 kwh/veh-km)
At Design Capacity . . . . . 0.77 kwh/veh-mi (0.48 kwh/veh-km)

STATIONS:

Type . . . . . On-line or off-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic machines
Security . . . . . Closed circuit TV
Boarding Capacity . . . . . I - 19,200 psgr/hr, II - 20,000 psgr/hr
Deboarding Capacity . . . . . I - 19,200 psgr/hr, II - 20,000 psgr/hr
Max Wait Time . . . . . 5 min
Vehicle in Station Dwell Time . . . . . 20 sec
Average Station Spacing . . . . . 0.3 - 0.5 mi (0.5 - 0.8 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . Not required
Stops . . . . . Stops at each station on fixed schedule, non-stop service provided with on-demand service.
Accommodation . . . . . Seated and standing
Comfort . . . . . Heated and air conditioned vehicles
Security . . . . . Emergency automatic announcement, intercom, rescue vehicles
Instruction . . . . . No special instruction for ordinary use except for on-demand service

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Signal equipment, ATC, ATO, emergency brake system
Fail Operational Features . . . . . Signal equipment, ATC, ATO, central computer, central commander
Total System Mean Time Before Failure . . . . . By system size
System Restore Time After Failure . . . . . By system size
Station Mean Time Before Failure . . . . . By station size
Station Restore Time After Failure . . . . . By station size
Vehicle Mean Time Before Failure . . . . . By use frequency
Strategy For Removal of Failed Vehicle . . . . . Operation by hand or propulsion by another vehicle brought to the rear of failed vehicle
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Refuge to guideway through assisting vehicle at rear
System Lifetime . . . . . By system size
Vehicle Lifetime . . . . . By system size

[1] PARATRAN I System
[2] PARATRAN II System
[3] Vehicle defined as pair of vehicles

MAINTENANCE:

Inspection Frequency (One-way guideway assumed) . . . . . .
Guideway, Station } . . . . . Automically scheduled via special maintenance and inspection system
Vehicle . . . . . 1 hr every 7 days/600 mi (1000 km)
Periodic Maintenance . . . . . .
Guideway, Station } . . . . . Automatically scheduled via special maintenance and inspection system
Vehicle . . . . . 10 hrs every 365 days/30,000 mi (50000 km)
Adjustments Required . . . . Guideway – cable, ACT, and switching inspection
Vehicle – brakes, ATO and ATC equipment inspection
Other Maintenance . . . . . .Communication equipment, computers, control board inspections

CARGO CAPABILITY:

Passenger Articles . . . . . Small articles, luggage and wheelchairs
Goods Movement . . . . . .Small freight vehicles can be provided

PERSONNEL REQUIREMENTS:

Typical System of 120 vehicles, 15 stations and 10 mi (16 km) of one-way guideway
No. of Operators/Vehicle . . . . . None
No. of Attendants/Station 3
No. of Administrative Personnel 5
No. of Central Control Attendants . . . . . 6/18 hrs
No. of Maintenance Personnel 50
Engineering Staff . . . . . By system operational specifications

PHYSICAL DESCRIPTION

VEHICLE: (II - 2 car unit)

Overall Length . . . . . I - 49.2 , II - 47.9 ft (I - 15, II - 14.6 m)
Overall Width . . . . . 7.22 ft (2.2 m)
Overall Height . . . . . I - 9.84, II - 10.5 ft (I - 3.0, II - 3.2 m)
Empty Weight . . . . . I - 24,000, II - 30,000 lbs (I - 10909, II - 13600 kg)
Gross Weight . . . . . I - 34,000, II - 40,000 lbs (I - 15455, II - 18000 kg)
Passenger Space (Design Load) . . . . . I - 1.54 ft^2 (I - 0.14 m^2) seated
II - 1.54 ft^2 (II - 0.14 m^2) seated
I - 2.63 ft^2 (I - 0.24 m^2) standing
II - 1.33 ft^2 (II - 0.13 m^2) standing
Doorway Width . . . . . 39.4 in (1000 mm)
Doorway Height . . . . . 74.9 in (1900 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . I - Pneumatic rubber tires, coil springs, shock absorbers
II - Pneumatic rubber tires, leaf springs
Design Load . . . . . I - 8,500 lbs (I - 3,864 kg)/front suspension
II - 9,920 lbs (II - 4500 kg)/front suspension
I - 8,500 lbs (I - 3864 kg)/rear suspension
II - 9,920 lbs (II 4500 kg)/rear suspension
Lateral Guidance . . . . . .Power steering units controlled by lateral guidewheel — I - located in center slot, II - located with the sidewall of guideway

PROPULSION & BRAKING:

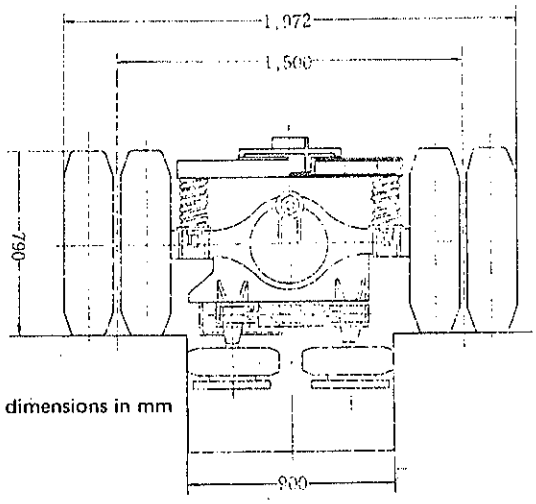
Type & No. Motors . . . . . .Traction drive dc motor, (250 V, 250 A)
Motor Placement . . . . . One each per single vehicle
Motor Rating . . . . . 75 HP, 55 kw at 1800 rpm
Type Drive . . . . . Cardan shaft drive
Gear Ratio 9.55:1
Type Power . . . . . 400 vac 3ϕ390 max amps
Power Collection . . . . . .Power collectors on vehicle, copper bus bars on guideway
Type Service Brakes . . . . . .Dynamic regenerative and hydraulic
Type Emergency Brakes . . . . . .Hydraulic
Emergency Brake Reaction Time . . . . . Data unavailable

SWITCHING:

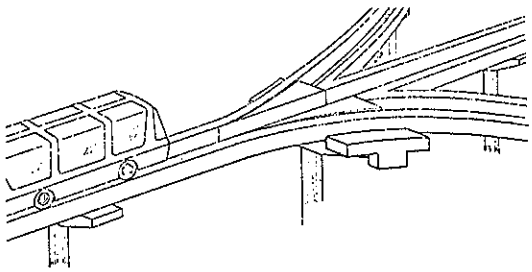
Type & Emplacement . . . . . Electromechanically operated switch table, on-board switching available
Switch Time (lock-to-lock) . . . . . I - 4, II - 2 sec
Speed Thru Switch . . . . . Data unavailable
Headway Thru Switch . . . . . I - 90, II - 60 sec min

GUIDEWAY:

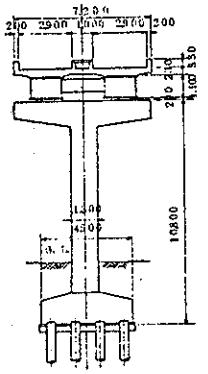
Type . . . . . I - Dual beam road surface
II - slab type construction above the road
Materials . . . . . .I - prestressed concrete, II - steel/concrete composition
Running Surface Width . . . . . I - 8.65 ft (I - 2640 mm)
II - 9.50 ft (II - 2900 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . I - 49 ft (I - 15000 mm)
II - 164 ft (II - 50000 mm)
Overall Cross Section Width . . . . . I - 8.7 ft (I - 2630 mm)
II - 10.8 ft (II - 3300 mm)



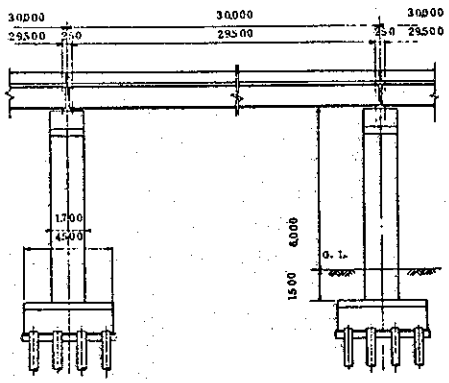
PARATRAN I SUSPENSION AND GUIDANCE SYSTEM



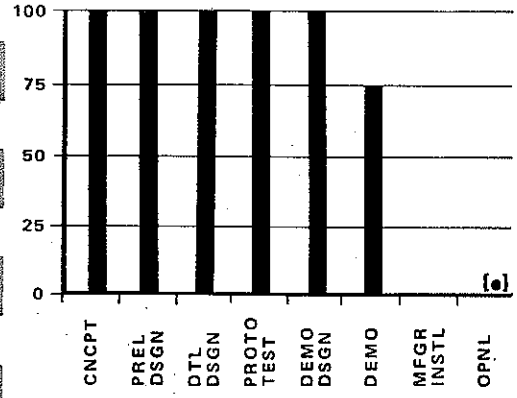
GUIDEWAY SWITCH TABLE



PARATRAN II GUIDEWAY SIDE VIEW



PARATRAN II GUIDEWAY CROSS SECTION



DEVELOPMENT STATUS

Overall Cross Section Height . . . . . I - 5.9 ft (I - 1800 mm)
II - 6.1 ft (II - 1860 mm)
Design Load . . . . . II - 874 lbs/ft (1300 kg/m)
Double Lane Elevated Guideway: (Type II info only)
Max Elevated Span . . . . . 164 ft (50 m)
Overall Cross Section Width . . . . . 23.6 ft (7200 mm)
Overall Cross Section Height . . . . . 35.1 ft (10700 mm)
Design Load . . . . . II-1,750 lbs/ft (2600 kg/m)
Guideway Passenger Emergency Egress . . . . . Passenger refuge to guideway, and walk to the near station, each station has steps to ground
Type Elevated Guideway Support Columns . . . . . Data unavailable

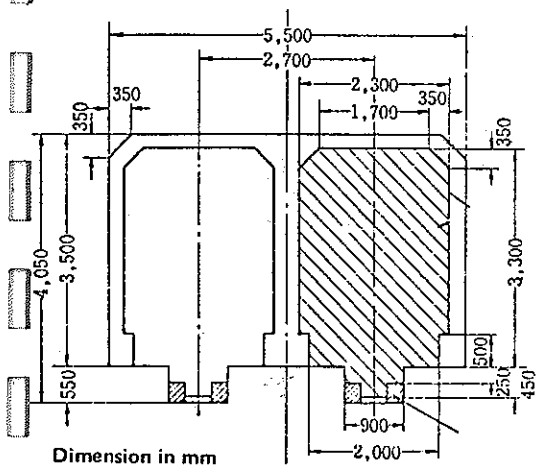
CONTROL:

Totally automatic operation with a central computer which commands train velocity, acceleration and braking, door control, announcements, etc. System utilizes conventional Automatic Train Operation (ATO) and Automatic Train Control (ATC) equipment. Headway is controlled via fixed one-block-one-train system.

STATIONS:

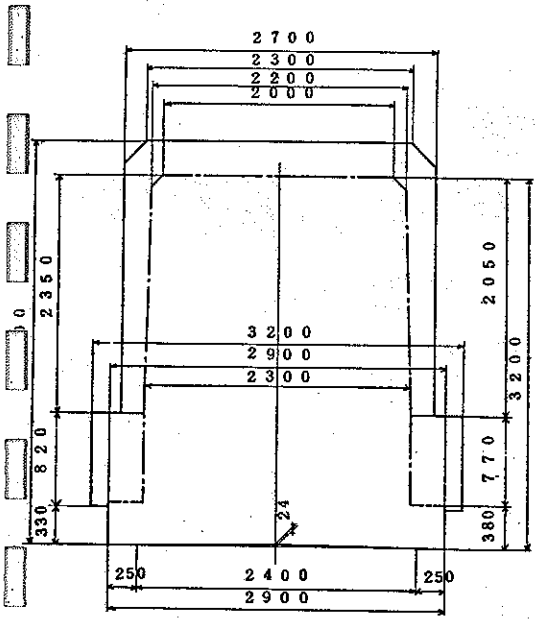
Stations are enclosed shelters nominally 197 ft (60 m) in length. Facilities provided are ticketing and fare collection equipment and restrooms. Access is via stairs, elevator, and/or escalators.

Loading/unloading platform width is 8.2-9.8 ft (2.5-3m).



Dimension in mm

PARATRAN I GUIDEWAY INSTALLATION ENVELOPE



PARATRAN II GUIDEWAY INSTALLATION ENVELOPE

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The concept was developed and designed between 1970 and 1972. A 1:50 model was built and tested in 1972. Full scale test of prototype equipment (vehicle, guideway, and control) were begun in 1973 and are presently still underway. The experiences gained from the COMTRAC system, the Japanese National Railways at Expo, the rail system in Sapporo, and CVS PRT system makes the traffic control system almost readily available.

Development of PARATRAN II began in 1974, and is continuing.

INSTALLATIONS & CONTRACTS:

Installations — Full scale prototype test facility, 100 m long, located at Tokyu Car Corporation

Contracts — (all have taken action to receive order)

Tokadai new town in Aichi Pref.
Osaka South Harbor
Kobe Port-island
Nankai Electric Railway Company
Tsukuba Educational Institution City

COSTS:

(Based upon typical system of 10 mi (16 km) double lane guideway, 15 stations, 120 vehicles, 12 veh-mi/day, 7 veh-hr/day, 18 hrs operation per day)
Capital Cost (PARATRAN II) . . . . . Total avg of $13,000,000/mi ($8,000,000/km) single lane
Avg Cost per 2-Car Unit $350,000
Avg Cost per Double Lane Guideway $5,600,000/mi ($3,500,000/km)
Avg Cost per Station $800,000
Computers, Software, & Control Center $1,500,000
Maintenance & Storage Facilities $5,000,000
Power Distribution & Substations $300,000
Operation & Maintenance Costs . . . . . Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width, Single Lane Guideway Envelope Height . . . . . See drawing at left
Single Lane Guideway Structural Weight . . . . . II - 1340 lbs/ft (II - 2000 kg/m)
Double Lane Guideway Structural Weight . . . . . II - 2680 lbs/ft (II - 4000 kg/m)
Max Grade 7%
Min Vertical Turn Radius . . . . . 1640 ft (500 m)
Min Horizontal Turn Radius . . . . . 98.4 ft (30 m) at 11.2 mph (18 km/h)
Construction Process . . . . . Prefabricated guideway sections
Staging Capability . . . . . Sections can be built and operated while others under construction.

LIMITATIONS: [e]

Overall size of vehicle and guideway limits retrofit installations to uncrowded sites unless major modifications are made to existing structures. Permission of standees limits service accel/decel to approx 4.4 ft/s^2 (1.34 m/s^2). On-guideway switch, fixed block headway control, and train operation limits min headway to 90 sec.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . (PARATRAN I)
H_1 — 2 ft (600 mm), H_2 — 12.8 ft (3900 mm)
W_1 — 7.35 ft (2240 mm), W_2 — 7.35 ft (2240 mm)
P_1 — 6.6 ft (2010 mm), P_2 — 13.6 ft (4150 mm)
Noise . . . . . (PARATRAN II) 70 dbA at 33 ft (10 m) above
70 dbA at 33 ft (10 m) to side
Noise . . . . . (PARATRAN I) 70 dbA at 25 ft (7.5 m) from guideway
70 dbA inside vehicle

PROJECT 21 RAPID TRANSIT SYSTEM

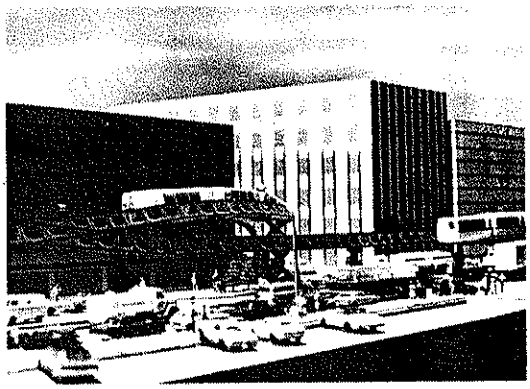
CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Transit Innovations
Post Office Box 11335
Palo Alto, California 94306
U.S.A.
Tel: (415) 493-3344

LICENSEES: Limited License Privileges
Lockheed Aircraft Corp.
Burbank, California 91503

PATENTS: U.S. patent no. 3,890,904 issued June 24, 1975.
Four design patents pending.



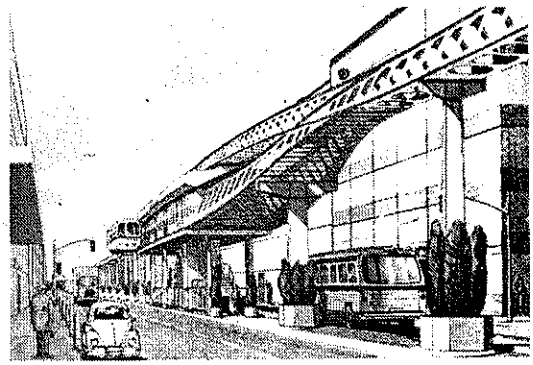
SMALL SCALE MODEL

DATA REFERENCE CODE: [a 21: except as noted]

SYSTEM DESCRIPTION:

Project 21 is a scaled-down form of Rail Rapid Transit, optimized for elevated application in existing cities. It employs small cars (20-22 seats) which can operate singly or in trains of up to four cars, electrically powered via a third rail. The guideway permits two-way traffic on a single slender beam. The two tracks diverge at stations so that a common station platform serves two-way traffic; off-line stations are also possible with the through line above the station.

A key feature of the system is a simple, compact switch for two-way traffic, useful for branch lines as well as off-line stations.

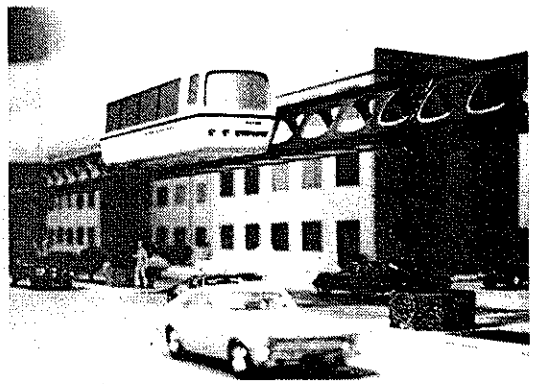


TYPICAL OFF-LINE STATION

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

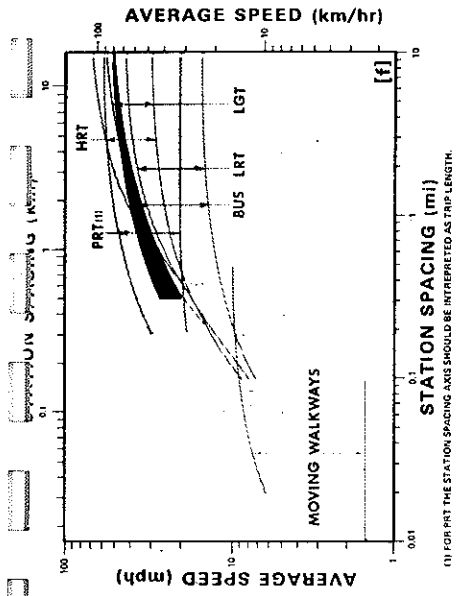
Max Theoretical One-Way Capacity	21,456 psgr/hr [f]
Max Practical One-Way Capacity	20,000 psgr/hr [f]
Min Theoretical Headway	25 sec
Min Practical Headway	60 sec [f]
Availability	Scheduled
Type Service	Large area collection/distribution
Type Network	Linear, two-way (trunk and branch lines)
Type of Vehicle Routing	Fixed
Traveling Unit	Single and/or 2 - 4 car trains

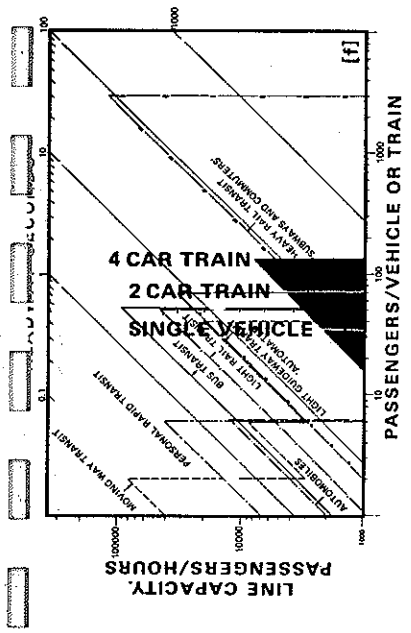


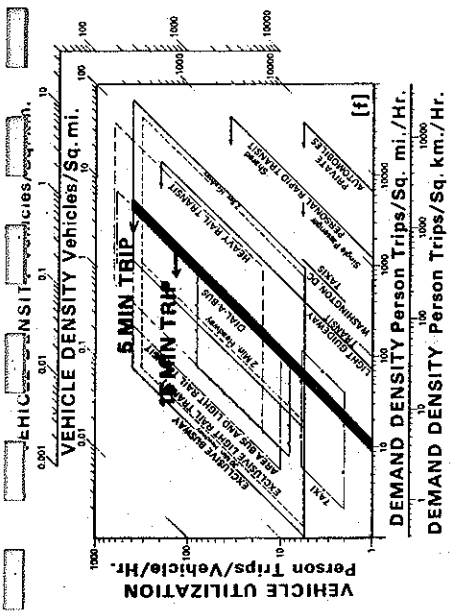
SCALE MODEL OF VEHICLE ON GUIDEWAY

VEHICLE PERFORMANCE:

Cruise Velocity	50 mph (81 km/h)
Max Velocity	50 mph (81 km/h)
Max Grade	Greater than 12%
Service Acceleration	Data unavailable
Service Deceleration	Data unavailable
Max Jerk	Data unavailable
Emergency Decel	Data unavailable
Stopping Precision in Station	1 - 2 in (25.4 - 50.8 mm)
Degradation if Guideway is Wet	10 - 12% for safe braking margin
Degradation for Ice and Snow	10 - 12% for safe braking margin
Vehicle Design Capacity	20 seated 15 standing
Vehicle Crush Capacity	20 seated 20 standing
Energy Consumption, Accelerating and Decelerating Only	
Empty Vehicle	Data unavailable
At Design Capacity	Data unavailable







Energy Consumption, Cruise Only
- Empty Vehicle . . . . . 0.60 - 0.67 kwh/veh-mi (0.37 - 0.42 kwh/veh-km)
- At Design Capacity . . . . . 0.68 - 0.75 kwh/veh-mi (0.42 - 0.47 kwh/veh-km)

STATIONS:

- Type . . . . . On-line or off-line, generally elevated
- Type Boarding . . . . . Level
- Ticket or Fare Collection . . . . . Rail rapid transit type
- Security . . . . . Closed circuit TV and two-way voice
- Boarding Capacity . . . . . 10,400 psgr/hr/platform
- Deboarding Capacity . . . . . 10,400 psgr/hr/platform
- Max Wait Time . . . . . Data unavailable
- Vehicle in Station Dwell Time . . . . . Data unavailable
- Average Station Spacing . . . . . 0.25 - 0.50 mi (0.40 - 0.50 km)

INDIVIDUAL SERVICE:

- Privacy . . . . . Passengers share vehicles.
- Transfers . . . . . Minimized by branch capabilities
- Stops . . . . . Vehicle stops at stations.
- Accommodation . . . . . Seated and standing
- Comfort . . . . . Heating and air-conditioning
- Security . . . . . TV display can be provided for operator in lead car.
- Instruction . . . . . Data unavailable

RELIABILITY AND SAFETY:

- Fail Safe Features . . . . . Positive grip around both railheads including passage through switch
- Fail Operational Features . . . . . Power failure, battery for lights and communications; redundant upper-suspension elements including power pick-up; redundant propulsion motors, disk and tread brakes
- Total System Mean Time Before Failure
- System Restore Time After Failure
- Station Mean Time Before Failure
- Station Restore Time After Failure
- Vehicle Mean Time Before Failure

} . . . . . Data unavailable

- Strategy For Removal of Failed Vehicle . . . . . .Push cars to switch/spur (one every 3-4 mi)
- Strategy for Passenger Evacuation of Failed Vehicle . . . . . Operable train stops adjacent to stalled train; passengers cross over through portholes in beam, or exit rear door to guideway.
- System Lifetime . . . . . .(Target) 40 years
- Vehicle Lifetime . . . . . 15 years

MAINTENANCE:

- Inspection Frequency (One-way guideway assumed)
  - Guideway
  - Station
  - Vehicle
- Periodic Maintenance
  - Guideway
  - Station
  - Vehicle

} . . . . . Data unavailable

- Adjustments Required
- Other Maintenance . . . . . Vehicle, guideway and switches are of modular design. Maintenance personnel travel and work inside the guideway, where they have access to system circuitry and switch mechanisms without traffic disruption or hazard to personnel.

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages, hand lugguage and wheelchairs
Goods Movement . . . . . Has not been studied

PERSONNEL REQUIREMENTS:

No. of Operators/Vehicle . . . . . One per train
No. of Attendants/Station . . . . . Stations unattended
No. of Administrative Personnel
No. of Central Control Attendants
No. of Maintenance Personnel
Engineering Staff
. . . . . Data unavailable

PHYSICAL DESCRIPTION

VEHICLE: (Lead car/B-car)

Overall Length . . . . . 28.5/25.7 ft (8.69/7.84 m)
Overall Width . . . . . 7.7/7.7 ft (2.35/2.35 m)
Overall Height . . . . . 7.9/7.9 ft (2.41/2.41 m)
Empty Weight . . . . . 9,850/9,400 lbs (4467/4263 kg)
Gross Weight . . . . . 16,000/16,000 lbs (7256/7256 kg)
Passenger Space (Design Load) . . . 100/110 ft^2 (9.2/10.1 m^2) seated
40/58 ft^2 (3.7/5.3 m^2) standing
Doorway Width . . . . . 46.1 in (1171 mm)
Doorway Height . . . . . 75 in (1905 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . Slanting main wheels engage lower rails; two per car, steel rimmed, resilient, redundant fiber-rimmed rollers engage upper rail to prevent overturning.
Design Load . . . . . 11,000 lbs (4989 kg)/main wheel
5,500 lbs (2494 kg)/outrigger
Lateral Guidance . . . . . Dual flanges on main-wheel rims

PROPULSION & BRAKING:

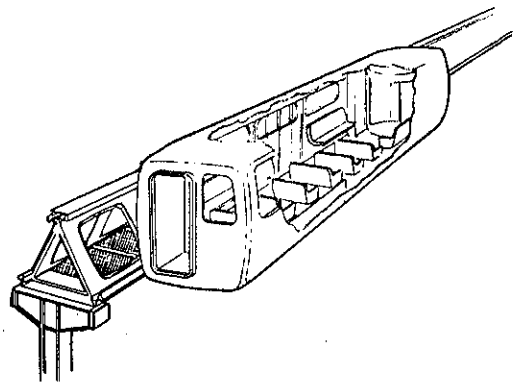
Type & No. Motors . . . . . 2 electric motors
Motor Placement . . . . . Each main wheel
Motor Rating . . . . . 60 HP/wheel at 4800 rpm
Type Drive . . . . . Worm or hypoid gear
Gear Ratio 6.125:1
Type Power . . . . . 600 vdc, can be single phase ac
Power Collection . . . . . Third rail, shoe on upper suspension
Type Service Brakes . . . . . Regenerative and disc brakes
Type Emergency Brakes . . . . . Disc and tread brakes
Emergency Brake Reaction Time . . . . . Data unavailable

SWITCHING:

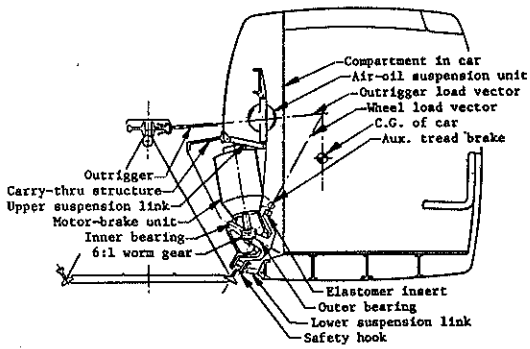
Type & Emplacement . . . . . Works in an inclined plane; three movable elements, one activator, dual switches back to back
Switch Time (lock-to-lock) . . . . . 1.0 sec [a 4]
Speed Thru Switch (on line) . . . . . 50 mph (81 km/h) max
Headway Thru Switch . . . . . 25 sec min [a 4]

GUIDEWAY:

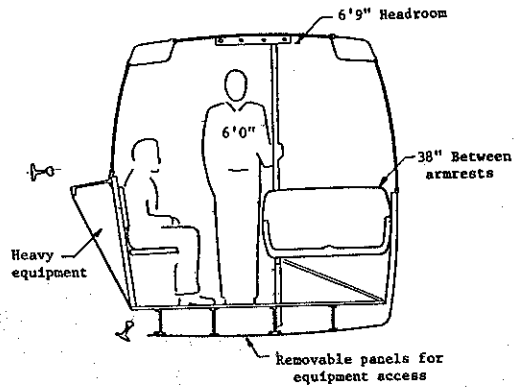
Type . . . . . Welded beam with integral rails
Materials . . . . . Steel
Running Surface Width (rail to rail) . . . . . 4.40 ft (1370 mm)
Single Lane Elevated Guideway:
Max Elevated Span
Overall Cross Section Width
Overall Cross Section Height
Design Load
. . . . . Data unavailable



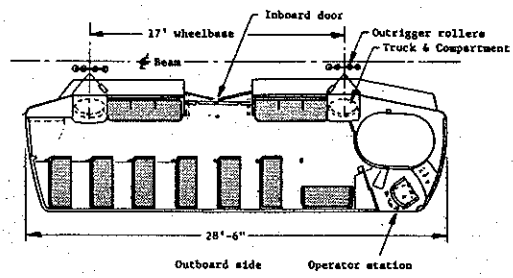
PERSPECTIVE CUTAWAY SKETCH



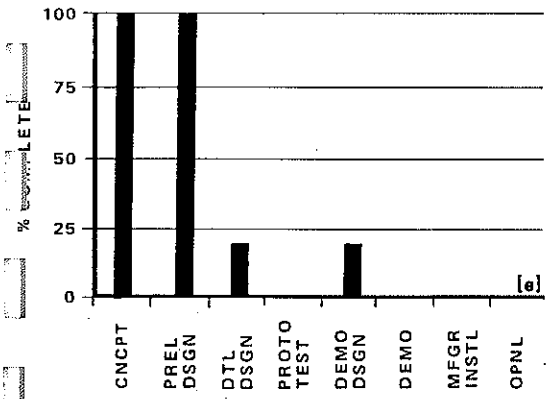
SECTION THRU CAR AT WHEEL



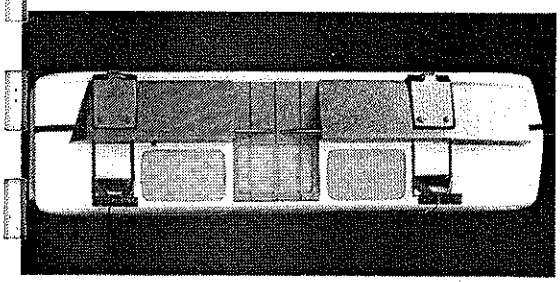
SECTION THRU CAR IN SEAT AREA



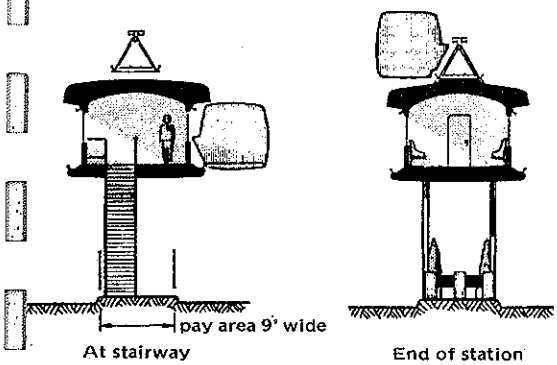
FLOOR PLAN OF CAR

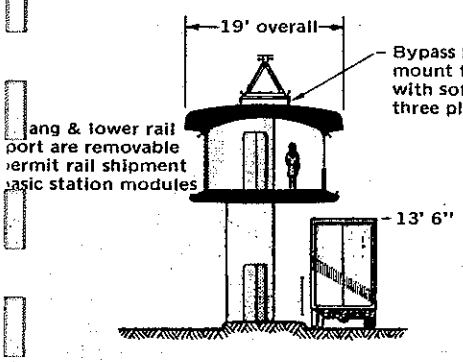


DEVELOPMENT STATUS



INBOARD SIDE OF CAR





END VIEWS AT STATIONS

Double Lane Elevated Guideway:

Max Elevated Span	64.5 basic/90.0 ft special (19.7/27.4 m)
Overall Cross Section Width	5.5 ft (1676.4 mm)
Overall Cross Section Height	4.7 ft (1432.6 mm)
Design Load	1,560 lbs/ft (707 kg/m)
Guideway Passenger Emergency Egress	Passengers pass through beamed guideway.
Type Elevated Guideway Support Columns	Prefabricated steel weldment, anchor via 6 stud bolts to a flat concrete pad

CONTROL:

Basic system has operator control with aids and overrides customary in LRT/RRT (according to owner's requirements).

System is amendable to complete automation.

STATIONS:

Basic station for two-way traffic is 17 ft wide by 130 ft long to accommodate four-car trains. Fully enclosed (except at stairwells) for environmental control and passenger safety. There are individual doors for each car of the train; opening/closing is coupled to train's stopping/starting. There are two stairways and a 32-ft^2 elevator suitable for wheelchairs or up to 16 adults. Fenced-in "paid" area is at ground level, 9 ft x 114 ft. Entire station fits in the 10 ft median of a major city street. Off-line station is as just described except that it is 19 ft wide. Bypassing express trains arch over the station at 50 mph within normal comfort limits.

Smaller stations for 2 or 3 car trains are possible.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Conceived at Lockheed in 1971 and studied there until late 1972; subsequent work by Transit Innovations has concentrated heavily on details of the guideway, switch, suspension, and stations. Basic guideway design is virtually complete; its structure and dynamics have been cross-checked by specialists. Models have been made of key features. Critical engineering reviews have been held in six U.S. and three Canadian cities, including UMTA in Washington.

INSTALLATIONS & CONTRACTS:

None at present. Preliminary discussions with Los Angeles, California, and several other cities in the U.S. and Canada.

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Dual Lane Guideway Envelope Width	20 ft (6096 mm)
Dual Lane Guideway Envelope Height	8.0 ft (2438 mm)
Double Lane Guideway Structural Weight	276.52 lbs/ft (411.37 kg/m)
Max Grade	10 - 12%
Min Vertical Turn Radius	300 ft (91.4 m) at 27 mph (43.5 km/h)
Min Horizontal Turn Radius	90 ft (27.43 m) at 15 mph (24.1 km/h)
Construction Process	Prefabricated beams, columns, switches and station
Staging Capability	Sections may be operated by providing loops at end of lines.

LIMITATIONS:

Retrofit requires a 20 ft clear span. Speed in turns predicted on a 9° maximum super-elevation. Guideway is stressed for infinitely long trains, rated to 0.5 g earthquakes and 100 mph (160.9 km/hr) wind speed.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emission

Visual, Single Lane Elevated Guideway . . . . . .

H_1 – 4.7 ft (1.43 m), H_2 – 7.9 ft (2.41 m)

W_1 – 5.5 ft (1.68 m), W_2 – 19.9 ft (6.07 m)

P_1 – 5.6 ft (1.71 m), P_2 – 18.4 ft (5.61 m)

Noise . . . . . Data unavailable

ROHR MONORAIL "J" and "K" SERIES

CLASSIFICATION: Light Guideway Transit

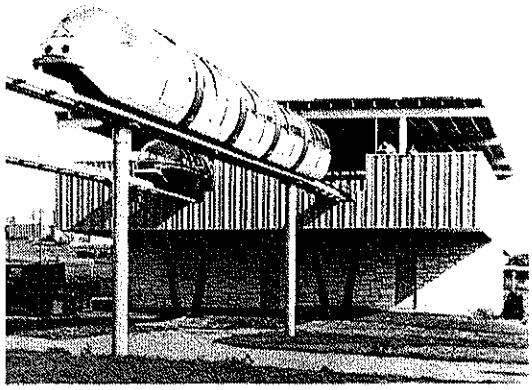
OTHER NAMES: None (formerly WABCO)

DEVELOPER: Rohr Industries, Inc.
Rohr Monorail Systems Division
P.O. Box 157
Cape May County Airport
Wildwood, New Jersey 08260, U.S.A.
Tel: (609) 522-2418

LICENSEES: None

PATENTS: Data unavailable

DATA REFERENCE CODE: [a 81: except as noted]

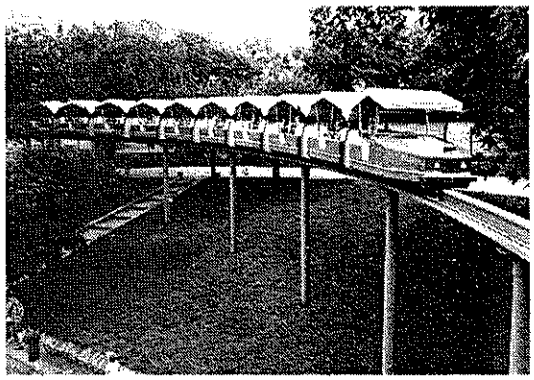


"K" SERIES AT DUTCH WONDERLAND LANCASTER, PA.

SYSTEM DESCRIPTION:

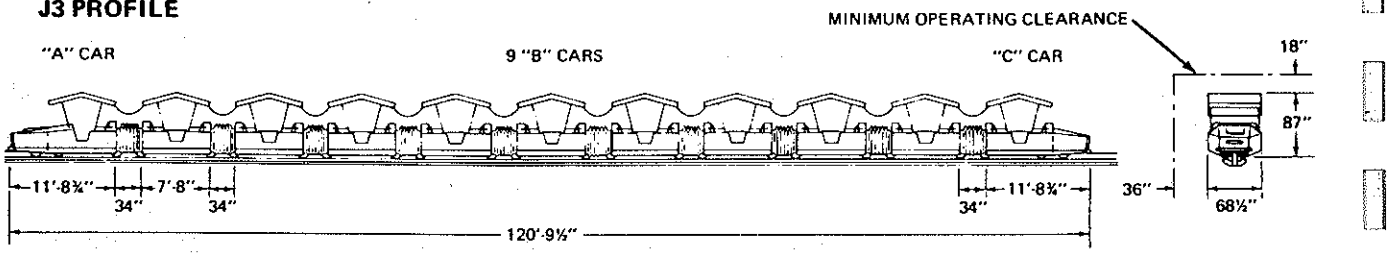
The "J" and "K" Series Monorail systems are manually or totally automatically operated, low-capacity systems for transporting passengers in trains of small light vehicles over an exclusive, elevated guideway, line or loop, in a major activity center. Both systems have essentially the same performance (except for speed) and utilize the same propulsion, suspension, and guideway systems. The variations are in vehicle design. The trains are articulated units utilizing a common propulsion and suspension unit at each articulated joint.

Cars for the "J" series are open to the environment while those of the "K" series are enclosed.

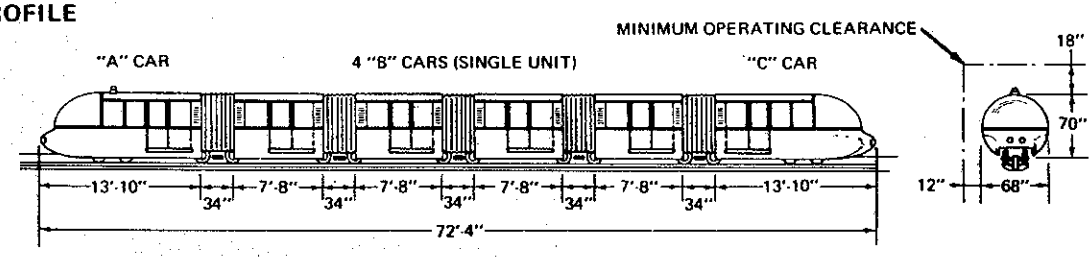


"J" SERIES AT PHILADELPHIA ZOO

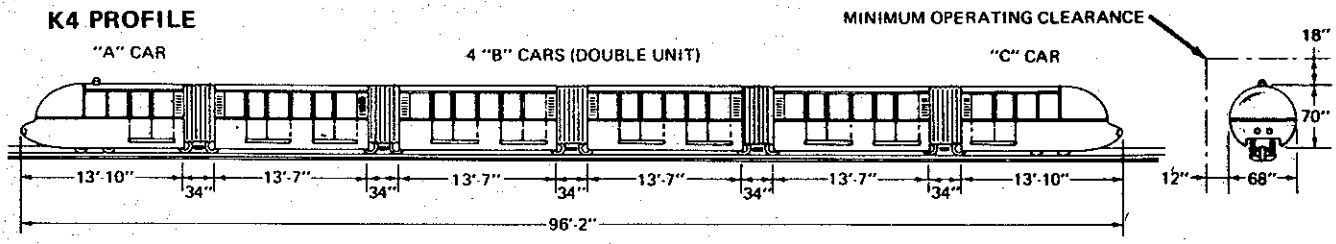
J3 PROFILE

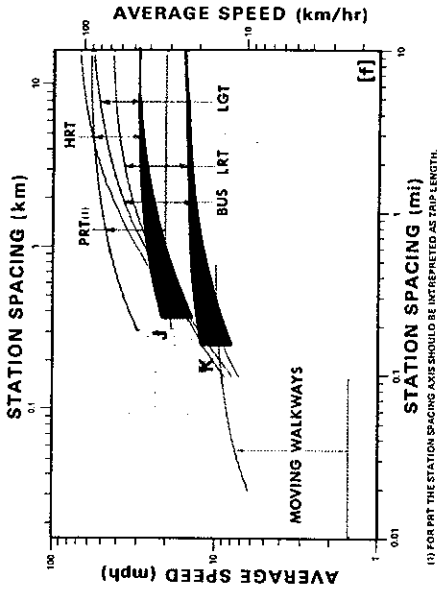


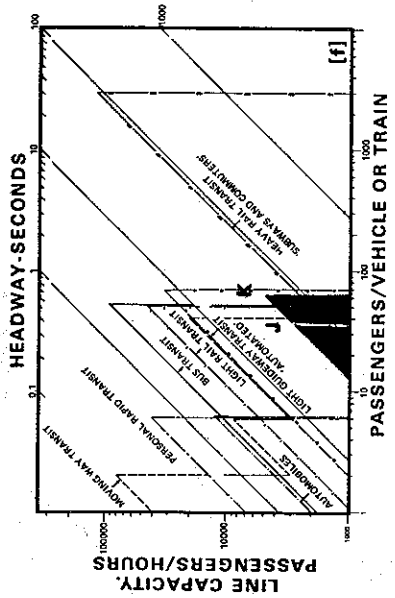
K6 PROFILE

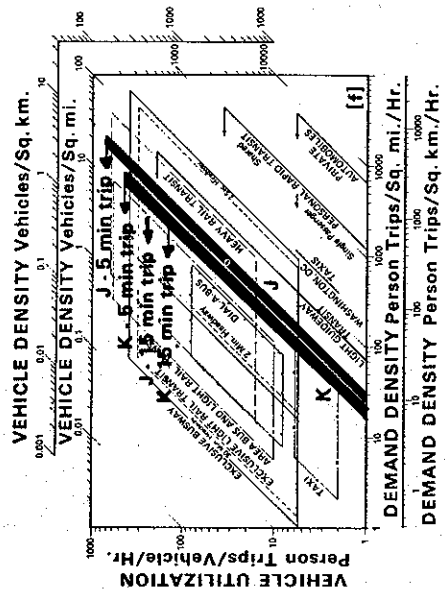


K4 PROFILE









OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . Up to 3,600 psgr/hr
Max Practical One-Way Capacity . . . . . Up to 3,600 psgr/hr
Min Theoretical Headway . . . . . 60 sec [f]
Min Practical Headway . . . . . Data unavailable
Availability . . . . . Scheduled [e]
Type Service . . . . . Point-to-point or limited linear or area collection & distribution [e]
Type Network . . . . . Linear or loops [e]
Type of Vehicle Routing . . . . . Fixed
Traveling Unit . . . . . Articulated trains

VEHICLE PERFORMANCE: [b 91]

Cruise Velocity . . . . . "J" - 15.0/"K" - 30.0 mph (24.2/48.3 km/h)
Max Velocity . . . . . Data unavailable
Max Grade 6%
Service Acceleration . . . . . 4.4 ft/s^2 (1.34 m/s^2)
Service Deceleration . . . . . 4.4 ft/s^2 (1.34 m/s^2)
Max Jerk . . . . . 2.2 ft/s^3 (0.67 m/s^3)
Emergency Decel . . . . . 4.8 ft/s^2 (1.46 m/s^2)
Stopping Precision in Station . . . . . ±6.0 in (152.4 mm)
Degradation if Guideway is . . . . . Wet / Ice/Snow

	Wet %	Ice/Snow %
Cruise Velocity "J"	20	33
Cruise Velocity "K"	16	33
Service Accel. & Decel.	16	33
Emergency decel.	8	24
Stopping Precision	66	100

Train Design Capacity . . . . . "J" - 60 seated 0 standing
Train Design Capacity . . . . . "K" - 36 or 60 seated 0 standing
Energy Consumption . . . . . Data unavailable

STATIONS:

Type . . . . . On-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . As required
Security . . . . . As required
Boarding Capacity . . . . . 3,600 psgr/hr [e]
Deboarding Capacity . . . . . 3,600 psgr/hr [e]
Max Wait Time . . . . . Approx 60 sec [e]
Vehicle in Station Dwell Time . . . . . Approx 30 sec [e]
Average Station Spacing . . . . . As required

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . As required
Stops . . . . . Train stops at all stations.
Accommodation . . . . . Seated only
Comfort . . . . . "J" open to environment [a]
"K" closed with climate control [a]
Security . . . . . As required
Instruction . . . . . Signs and announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Door locks on "K" series.
Fail Operational Features . . . . . Redundant propulsion units and brakes
Total System Mean Time Before Failure . . . . . 4,000 hrs
System Restore Time After Failure . . . . . 0.5 hrs
Station Mean Time Before Failure . . . . . 4,000 hrs
Station Restore Time After Failure . . . . . Data unavailable
Vehicle Mean Time Before Failure . . . . . 4,000 hrs
Strategy For Removal of Failed Vehicle . . . . . Data unavailable
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Data unavailable
System Lifetime . . . . . 20 years
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Data unavailable

CARGO CAPABILITY: [e]

Passenger Articles . . . . . Small packages only
Goods Movement . . . . . Not provided

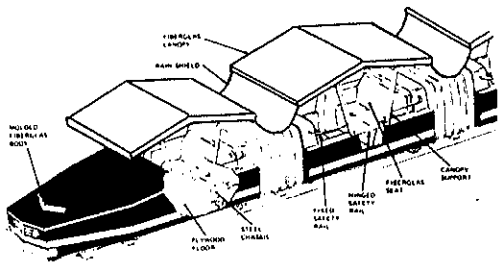
PERSONNEL REQUIREMENTS: [e]

Train operators for manual operation, attendant at control facility, and maintenance personnel

PHYSICAL DESCRIPTION

TRAIN: "J" Series

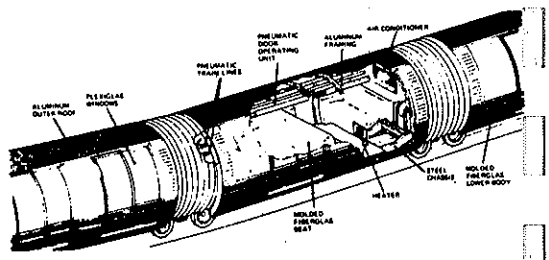
Overall Length . . . . . 121 ft (36881.0 mm)
Overall Width . . . . . 5.71 ft (1740.5 mm)
Overall Height . . . . . 7.25 ft (2209.8 mm)
Empty Weight . . . . . 27,600 lbs (12516.6 kg)
Gross Weight . . . . . 36,000 lbs (16326.0 kg)
Passenger Space (Design Load) . . . . . Data unavailable
Doorway Width . . . . . Data unavailable
Doorway Height . . . . . Data unavailable



"J" SERIES VEHICLES

TRAIN: "K" Series [a 81]

Overall Length . . . . . K4 - 96/K6 - 72 ft (29261/21946 mm)
Overall Width . . . . . 5.67 ft (1728.2 mm)
Overall Height . . . . . 5.83 ft (1777.0 mm)
Empty Weight . . . . . K4 - 19,900/K6 - 15,400 lbs (9025/6984 kg)
Gross Weight . . . . . K4 - 28,900/K6 - 20,800 lbs (13106/9433 kg)
Passenger Space (Design Load) . . . . . Data unavailable
Doorway Width . . . . . Data unavailable
Doorway Height . . . . . Data unavailable



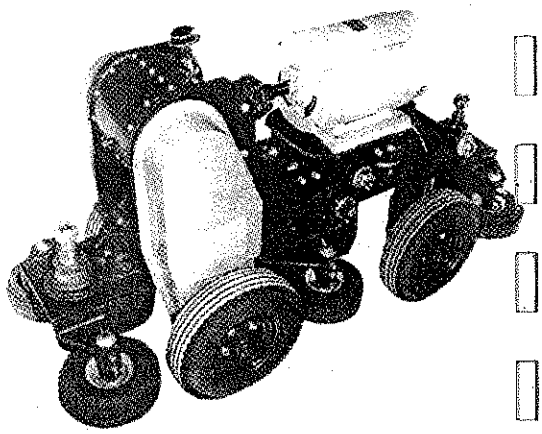
"K" SERIES VEHICLES

SUSPENSION:

Type . . . . . Supported by 4 pneumatic tires per articulated bogie, one bogie per joint. Air-bag springs
Design Load . . . . . Data unavailable
Obstacle Clearance . . . . . 1 ft (0.3 m)
Lateral Guidance . . 4 lateral pneumatic tired guidewheels constrained to follow center raised guidebeam

PROPULSION & BRAKING:

Type & No. Motors . . . . . Continuous duty cycle dc electric motor, one each per bogey
Motor Placement . . . . . On-board vehicle
Motor Rating . . . . . Up to 25 HP
Type Drive . . . . . Traction drive
Gear Ratio . . . . . Data unavailable
Type Power . . . . . Single phase ac with on-board rectification
Power Collection . . . . . Rails on guideway
Type Service Brakes . . . . . Dynamic plus drum brakes
Type Emergency Brakes . . . . . Electromechanical shaft
Emergency Brake Reaction Time . . . . . 1.0 sec



PROPULSION/DRIVE UNIT

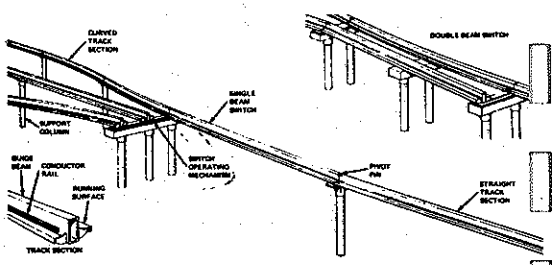
SWITCHING:

Type & Emplacement . . . . . Single beam or double beam, on-guideway
Switch Time (lock-to-lock) . . . . . Determined by system requirements
Speed Thru Switch . . . . . 10 mph (16 km/h) max
Headway Thru Switch . . . . . 60 sec min

GUIDEWAY: [a 91]

Type . . . . . Center box beam with running surfaces each side
Materials . . . . . Steel
Running Surface Width . . . . . 2.25 ft (685.8 mm)
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 90.0 ft (27432.0 mm)
- Overall Cross Section Width . . . . . 0.58 ft (176.8 mm)
- Overall Cross Section Height . . . . . 15.0 ft (4572.0 mm)
- Design Load . . . . . Data unavailable

Double Lane Elevated Guideway . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . Data unavailable
Type Elevated Guideway Support Columns . . . . . Steel



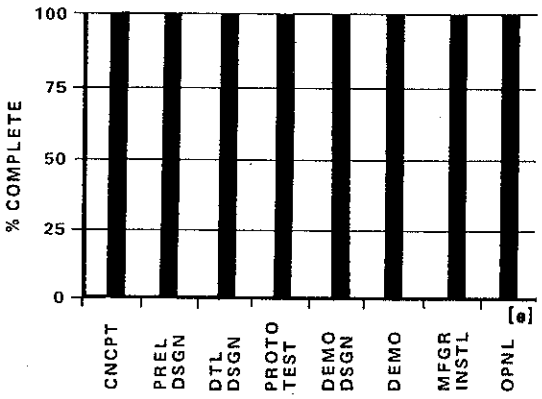
SWITCH

CONTROL: [a]

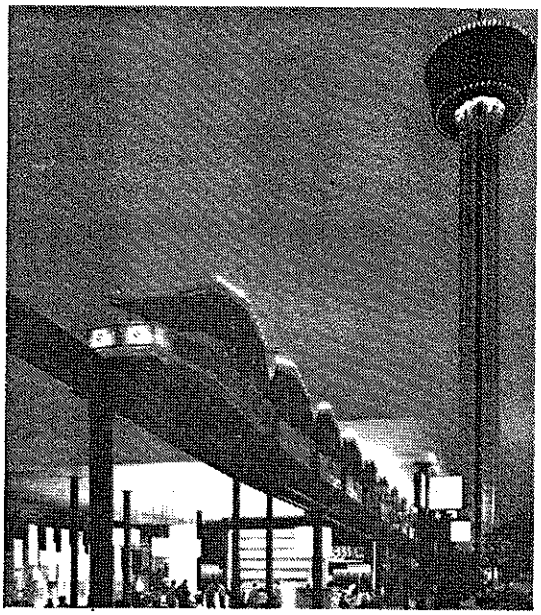
Control can range from manual (driver each train) to totally automatic. A number of options are offered for automated operation: Train Detection, Automatic Train Separation, Cab Signaling and Overspeed, and Automatic Train Operation. Automatic headway control uses a system of fixed blocks.

STATIONS: [e]

Stations are linear platforms designed to accommodate one full train length as required.



DEVELOPMENT STATUS



"J" SERIES AT HEMISFAIR

DEVELOPMENT HISTORY, PLANS & PROGRESS: [a]

The "J" and "K" series monorails were developed by Westinghouse Airbrake Company (WABCO) during the period June 1964 - June 1968. The first installation was at Dutch Wonderland in Lancaster, Pa. In August, 1972, the WABCO Monorail Division was acquired by Rohr Industries, Inc., and the Rohr Monorail Systems Division was set up. Systems can be designed and installed per customer specification from standard modular components. Firm price quotations are available.

INSTALLATIONS & CONTRACTS: [b]

J Series:

Atlantic City, N.J.	2,000 ft (610 m), 1 train, 1 station
San Antonio, Texas-Hemisfair	7,200 ft (2194 m), 10 trains, 3 stations
Philadelphia Zoo	5,200 ft (1585 m), 3 trains, 2 stations
Palisades Park, N.J.	2,000 ft (610 m), 2 trains, 1 station
Lake Geauga, Ohio	3,000 ft (914 m), 2 trains, 1 station
Bronx Zoo, New York City	10,000 ft (3048 m), 6 trains, 1 station
Cape May County Airport, N.J. (test track)	1,300 ft (396 m), 1 train

K Series:

Oklahoma State Fair Grounds	6,200 ft (1890 m), 3 trains, 1 station
Ocean City, Md.	2,160 ft (658 m), 1 train, 1 station
Wildwood, N.J.	1,200 ft (366 m), 1 train, 1 station
Dutch Wonderland, Lancaster, Pa.	3,500 ft (1067 m), 3 trains, 2 stations
Cape May County Airport, N.J. (test track)	1,300 ft (369 m), 1 train

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	"J" - 11.7/"K" - 7.67 ft (3566/2338 mm) [f]
Single Lane Guideway Envelope Height	"J" - 10.25/"K" - 8.83 ft (3124/2692 mm) [f]
Single Lane Guideway Structural Weight	110 lbs/ft (164 kg/m)
Double Lane Guideway Structural Weight	Data unavailable
Max Grade	6%
Min Vertical Turn Radius	Data unavailable
Min Horizontal Turn Radius	50 ft (15.2 m)
Construction Process	Prefabricated and modular
Staging Capability	Section of line and complete loops can be operated while others under construction

LIMITATIONS:

Installations would be limited to areas of lower capacity requirement as activity center circulators [e]. Installation of the "J" series would be limited to mild climates or within environmentally controlled areas [a]. Fixed-block control and guideway mounted switch fixes headway [e].

ENVIRONMENTAL IMPACT:

Emissions	No direct polluting emissions [e]
Visual, Single Lane Elevated Guideway	[f: approx values]
	H_1 – 1.25 ft (381 mm), H_2 – 7.25 ft (2210 mm)
	W_1 – 2.25 ft (685 mm), W_2 – 5.71 ft (1741 mm)
	P_1 – 1.9 ft (579 mm), P_2 – 8.2 ft (2500 mm)
Noise	NCA 60 inside vehicle [b 91]
	NCA 60 outside vehicle [b 91]

ROHR MONORAIL "M" and "N" SERIES RAILBUS

CLASSIFICATION: Light Guideway Transit

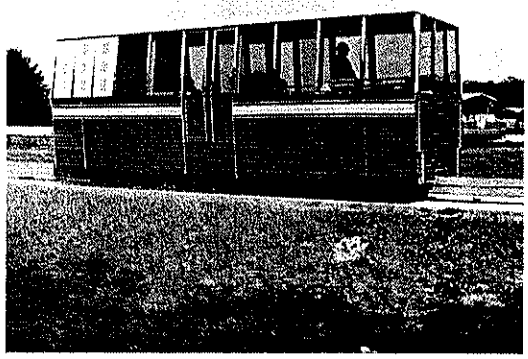
OTHER NAMES: None (formerly WABCO)

DEVELOPER: Rohr Industries, Inc.
Rohr Monorail Systems Division
P.O. Box 157
Cape May County Airport
Wildwood, New Jersey 08260, U.S.A.
Tel: (609) 522-2418

LICENSEES: None

PATENTS: Data unavailable

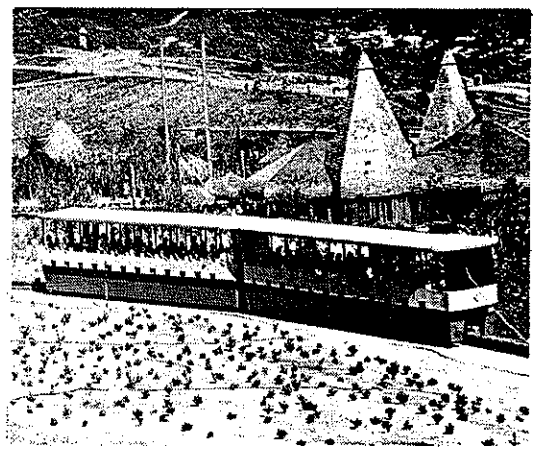
DATA REFERENCE CODE: [a 51: except as noted]



"M" SERIES RAILBUS
PROTOTYPE TEST VEHICLE

SYSTEM DESCRIPTION:

The "M" and "N" Series Railbus systems are medium capacity (9,000-12,000 psgr/hr) transit systems designed to carry passengers in small trains of 2 to 4 rubber tired vehicles over exclusive guideways. Control options range from manual to totally automated. Service can be point-to-point or collection/distribution as a line haul or around loops. The "M" series is designed for year round climates for a number of applications; whereas the "N" series, with its open cars, is designed for mild climates, as in amusement areas and sight-seeing applications. The technology and physical apparatus is essentially the same for both systems with variations on vehicle body design and performance.

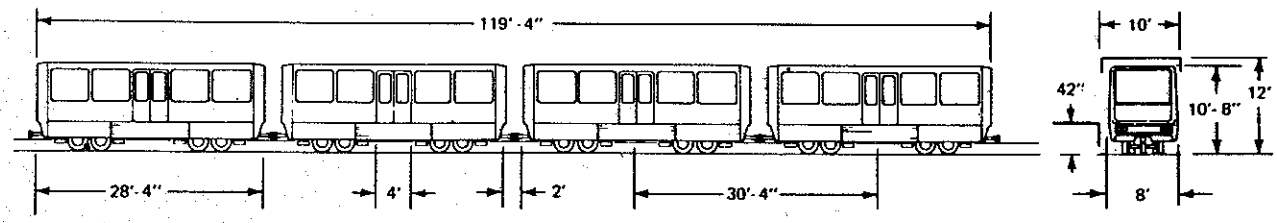


"N" SERIES RAILBUS AT
SAN DIEGO WILD ANIMAL PARK

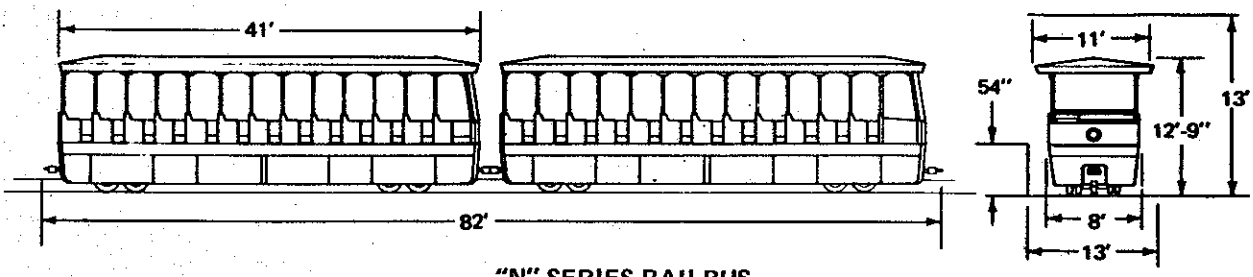
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE: [a 61: except as noted]

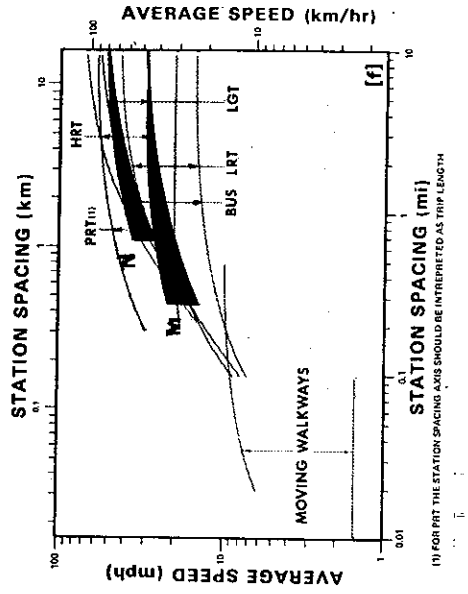
Max Theoretical One-Way Capacity	"M" - 10,800 to 15,600 psgr/hr [f] "N" - 9,000 psgr/hr [f]
Max Practical One-Way Capacity	Data unavailable
Min Theoretical Headway	60 sec
Min Practical Headway	Data unavailable
Availability	Scheduled
Type Service	Point-to-point or limited linear or area collection & distribution [e]
Type Network	Linear or loops
Type of Vehicle Routing	Fixed
Traveling Unit	"M" single to 4-vehicle trains "N" married vehicle pairs

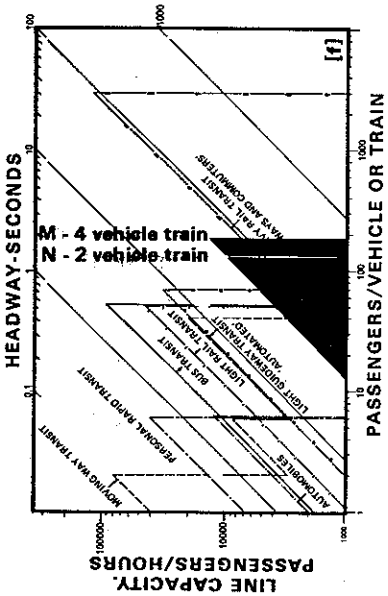


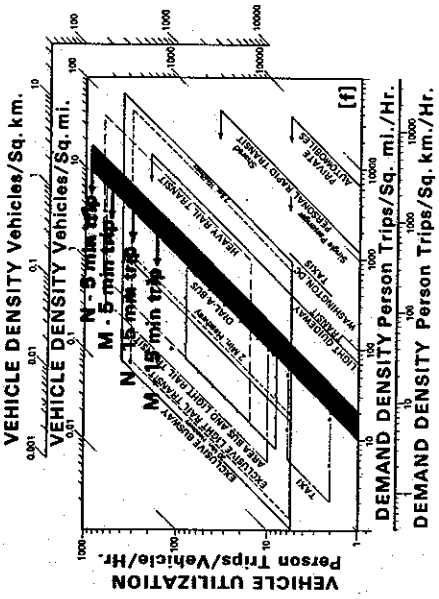
"M" SERIES RAILBUS



"N" SERIES RAILBUS







VEHICLE PERFORMANCE: [a 71]

Cruise Velocity . . . . . "M" - 30/"N" - 50 mph (48.2/80.5 km/h)
Max Velocity . . . . . "M" - 30/"N" - 50 mph (48.2/80.5 km/h)
Max Grade 6%
Service Acceleration . . . . . "M" - 4.4/"N" - 2.93 ft/s^2 (1.34/0.89 m/s^2)
Service Deceleration . . . . . "M" - 4.4/"N" - 4.4 ft/s^2 (1.34/1.34 m/s^2)
Max Jerk . . . . . "M" - 1.47/"N" - 2.2 ft/s^3 (0.45/0.67 m/s^3)
Emergency Decel . . . . . "M" - 4.84/"N" - 4.84 ft/s^2 (1.48/1.48 m/s^2)
Stopping Precision in Station . . . . . "M" - ±6.0 in (152.4 mm)
"N" - ±12 in (304.8 mm)
Degradation if Guideway is Wet . . . . . Data unavailable
Degradation for Ice & Snow . . . . . Data unavailable

Vehicle Design Capacity . . . . .

Series	Seated	Standing
"M"	30	15
"M"	30	17
"M"	34	18
"M"	26	28
"M"	10	55
"M"	0	72
"N" - A-Car	72	0
B-Car	78	0

Energy Consumption . . . . . Data unavailable

STATIONS: [a 61]

Type . . . . . On-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . As required
Security . . . . . As required
Boarding Capacity . . . . . Same as line capacity
Deboarding Capacity . . . . . Same as line capacity
Max Wait Time . . . . . Approx 60 sec [e]
Vehicle in Station Dwell Time . . . . . 30 sec [e]
Average Station Spacing . . . . . Data unavailable

INDIVIDUAL SERVICE: [e: except as noted]

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . As required
Stops . . . . . Train stops at all station with optional "by-pass" and "hold". [a]
Accommodation . . . . . "M" seated/standing, "N" seated only [a]
Comfort . . . . . "M" enclosed vehicle, "N" open vehicle [a]
Security . . . . . As required
Instruction . . . . . Signs and announcements

RELIABILITY & SAFETY: [a 61]

Fail Safe Features . . . . . Train cannot overturn, derail, run away, or collide with other trains.
Fail Operational Features . . . . . Emergency generators
Total System Mean Time Before Failure . . . . . Data unavailable
System Restore Time After Failure . . . . . 0.5 hrs
Station Mean Time Before Failure . . . . . Data unavailable
Station Restore Time After Failure . . . . . Data unavailable
Vehicle Mean Time Before Failure . . . . . 5000 hrs
Strategy For Removal of Failed Vehicle . . . . . Data unavailable
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Data unavailable
System Lifetime . . . . . 20 years
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . "M" - passenger articles, hand luggage, wheelchairs
"N" - small lap carried packages only [e]
Goods Movement . . . . . Utility car available with "M" series only [a]

PERSONNEL REQUIREMENTS:

Attendants at control facility & maintenance personnel plus drivers for vehicles if manual

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . "M" - 30.33/"N" - 41.0 ft (9245/12497 mm)
Overall Width . . . . . "M" - 8.0/"N" - 11.0 ft (2439/3353 mm)
Overall Height . . . . . "M" - 10.67/"N" - 12.75 ft (3252/3886 mm)
Empty Weight . . . . . "M" - 18,500/"N" - 19,000 lbs (8389/8617 kg)
Gross Weight . . . . "M" - 29,600/"N" - 29,800 lbs (13424/13515 kg)
Passenger Space (Design Load) . . . . . 4 ft^2 (0.368 m^2) seated
2.5 ft^2 (0.230 m^2) standing
Doorway Width . . . . . 57.6 in (1219.2 mm)
Doorway Height . . . . . 100.8 in (2133.6 mm)

SUSPENSION:

Type . . . . . Supported by 2 rubber tired bogies each vehicle
Design Load . . . . . 32,000 lbs (14512 kg)
Obstacle Clearance . . . . . 1.0 ft (0.3 m)
Lateral Guidance . . . Lateral rubber tired guidewheels, fixed to bogey, ride on center raised guiderail.

PROPULSION & BRAKING:

Type & No. Motors . . . . . DC electric motor, one motor each bogey
Motor Placement . . . . . One motor each bogey
Motor Rating . . . . . 50 HP
Type Drive . . . . . Traction drive
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 600 vac, single phase
Power Collection . . . . . Guideway conductor rail
Type Service Brakes . . . . . Electric dynamic, and air/hydraulic drum
Type Emergency Brakes . . . . . Motor shaft brake
Emergency Brake Reaction Time . . . . . 0.5 sec

SWITCHING:

Type & Emplacement . . . . . Moveable section of center guiderail
Switch Time (lock-to-lock) . . . . . 8 sec
Speed Thru Switch . . . . . Limited by radius of curvature only
Headway Thru Switch . . . . . 60 sec min

GUIDEWAY:

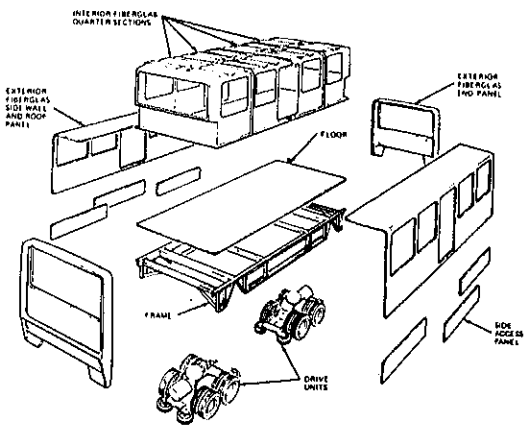
Type . . . . . Running surface with center guidebeam
Materials . . . . . Concrete surface, steel or aluminum guidebeams
Running Surface Width . . . . . 8.0 ft (2438.4 mm)
Single Lane Elevated Guideway:
Max Elevated Span . . . . . 90 ft (27432 mm)
Overall Cross Section Width . . . . . 1.25 ft (381.0 mm)
Overall Cross Section Height . . . . . 0.917 ft (279.5 mm)
Design Load . . . . . Data unavailable
Double Lane Elevated Guideway . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . Data unavailable
Type Elevated Guideway Support Columns . . . . . Data unavailable

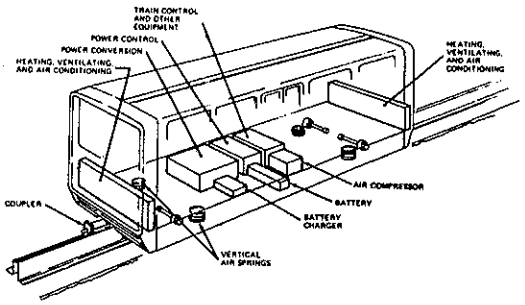
CONTROL: [a]

Range of options available from manual, (with automatic train separation) to fully automatic; options are Train Detection, Automatic Train Separation, Cab Signaling and Overspeed, and Automatic Train Operation. Headway control is via fixed block.

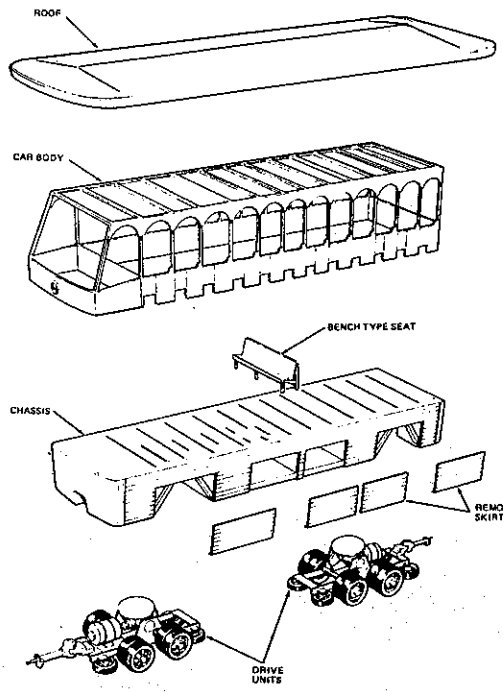
STATIONS: [e]

Essentially loading platforms.
"M" - At least 120 ft (36.6 m) long
"N" - At least 82 ft (25 m) long
Particular station design according to customer specification

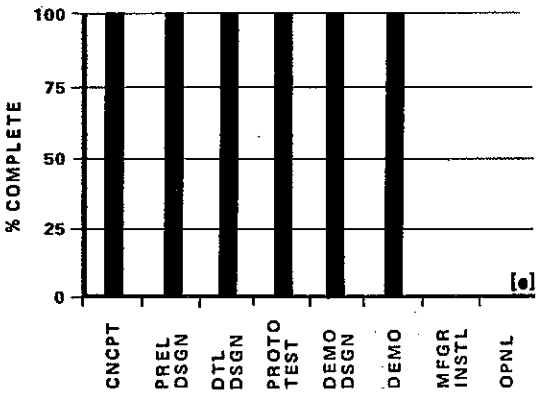




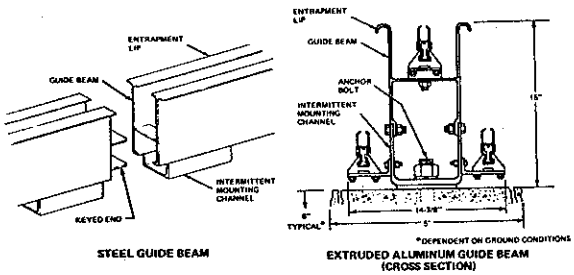
"M" SERIES VEHICLE



"N" SERIES VEHICLE



DEVELOPMENT STATUS



CENTER GUIDEBEAM

DEVELOPMENT HISTORY, PLANS & PROGRESS: [b]

Basic elements of both series (running gear and controls) have been in operation since 1968. Original development work was carried out by WABCO, during the period May, 1967, to October; 1968. Demonstration hardware can be seen at Cape May test track.

INSTALLATIONS & CONTRCTS: [b]

"N" Series is located at San Diego Wild Animal Park with 5 miles of single guideway, 13 trains, and 2 stations.

"M" Series test track is located at Cape May County Airport, New Jersey, with 1700 ft (518 m) of single guideway and one prototype vehicle.

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY: [a]

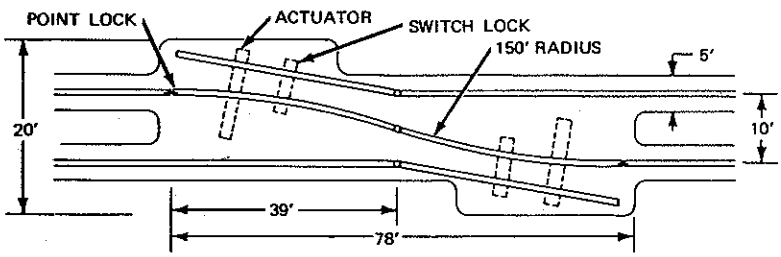
Single Lane Guideway Envelope Width . . . . "M" - 10.0 ft (3048 mm)
"N" - 13.0 ft (3963 mm)
Single Lane Guideway Envelope Height . . . . "M" - 12.0 ft (3658 mm)
"N" - 13.0 ft (3963 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 6%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 100 ft (30.5 m)
Construction Process . . . . . .Center guidebeam of standard lengths 40 ft (12.2 m) straight, 20 ft (6.1 m) curved
Staging Capability . . . . . Sections could be operated while others under construction

LIMITATIONS:

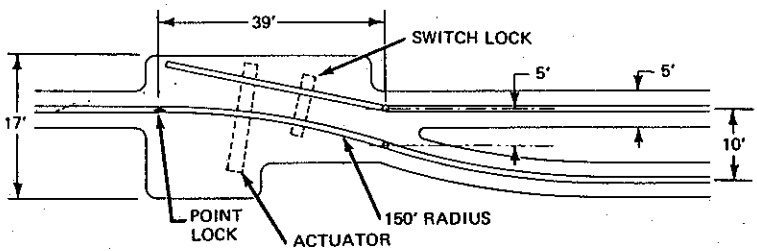
On-line stations limit average velocity.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual, Single Lane Elevated Guideway . . . . . Insufficient data to make assessment (present guideways at-grade)
Noise . . . . . .NCA 60 inside vehicle
NCA 60 at 100 ft (30.5 m) [b 71]



TURNOUT SWITCH FOR "M" SERIES
("N" Series has slightly different dimensions)



CROSS OVER SWITCH FOR "M" SERIES
("N" Series has slightly different dimensions)

ROHR MONORAIL "P" SERIES MONOTRAIN

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None (Formerly WABCO)

DEVELOPER: Rohr Industries, Inc.
Rohr Monorail Systems Division
P.O. Box 157
Cape May County Airport
Wildwood, New Jersey 08260, U.S.A.
Tel: (609) 522-2418

LICENSEES: None

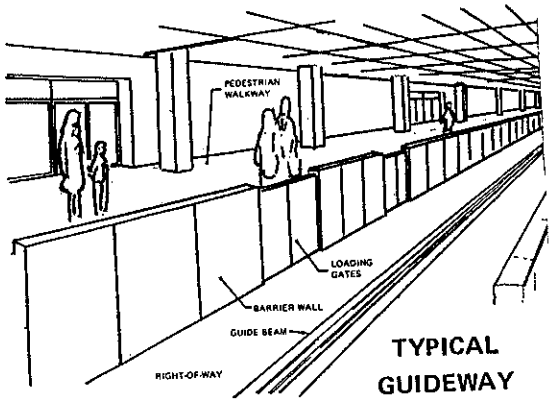
PATENTS: Data unavailable

DATA REFERENCE CODE: [a 61: except as noted]

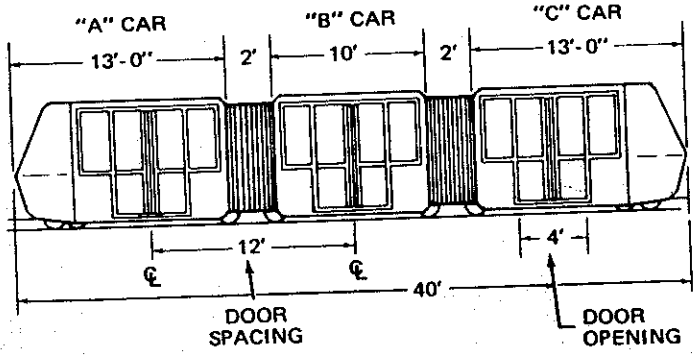
INSTALLATION AT HOUSTON AIRPORT

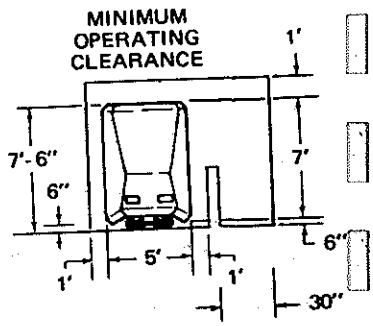
SYSTEM DESCRIPTION:

The "P" Series Monotrain is totally automated, low-capacity system for transporting passengers for short distances in trains of small light vehicles over an exclusive guideway line or loop in a major activity center. The system utilizes the same propulsion and suspension system as the "J" and "K" series. Trains are articulated units normally of 3 cars each. A small clearance envelope, modular guideway sections, and short station platform length and height are advantageous for installations within buildings. Drive units are capable of reverse operation at the same performance. Vehicles are totally enclosed for operation in an open environment as well.



TYPICAL GUIDEWAY



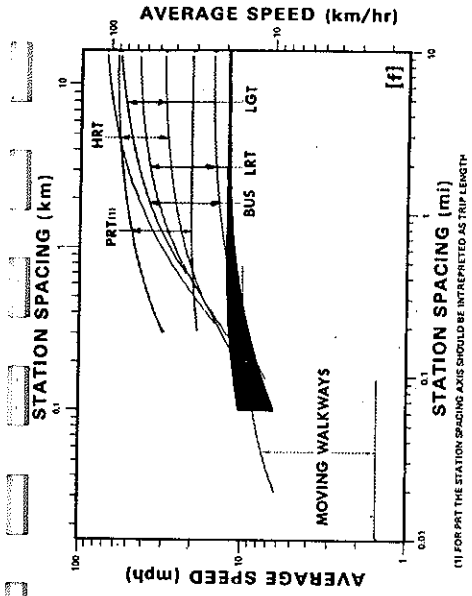


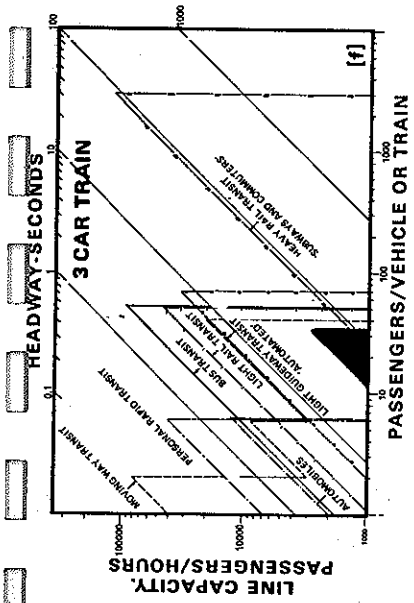
TRAIN CONFIGURATION

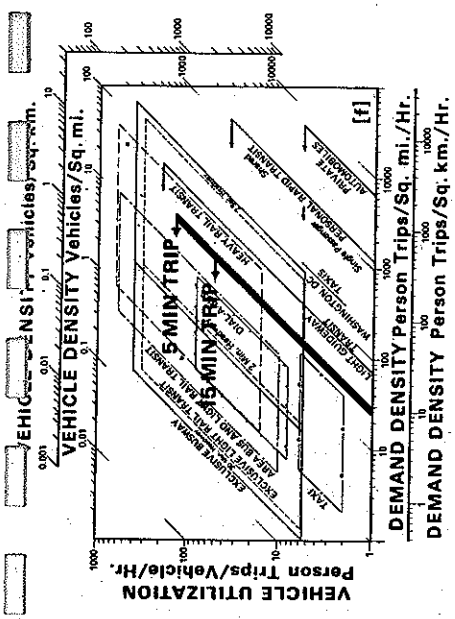
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	2,100 psgr/hr
Max Practical One-Way Capacity	2,100 psgr/hr
Min Theoretical Headway	60 sec
Min Practical Headway	60 sec
Availability	Scheduled
Type Service	Point-to-point or limited linear or area collection & distribution
Type Network	Linear or loops
Type of Vehicle Routing	Fixed
Traveling Unit	3 car articulated trains







VEHICLE PERFORMANCE:

Cruise Velocity	12 mph (19.3 km/h)
Max Velocity	15 mph (24.2 km/h)
Max Grade	2%
Service Acceleration	4.4 ft/s^2 (1.34 m/s^2)
Service Deceleration	4.4 ft/s^2 (1.34 m/s^2)
Max Jerk	2.2 ft/s^3 (0.67 m/s^3)
Emergency Decel	4.84 ft/s^2 (1.48 m/s^2)
Stopping Precision in Station	±6 in (152.4 mm)

Degradation of Guideway	% Wet	% Ice/Snow
Cruise Velocity	16.6	33.3
Max Velocity	20.0	33.3
Service Accel	16.5	33.4
Service Decel	16.5	33.4
Emergency Decel	9.0	24.2
Stopping Precision	33.3	66.7

Vehicle Design Capacity	6 seated 4-6 standing
Vehicle Crush Capacity	6 seated 8 standing
Energy Consumption	Data unavailable

STATIONS:

Type	On-line
Type Boarding	Level
Ticket or Fare Collection	As required
Security	As required
Boarding Capacity	2,160 psgr/hr [e]
Deboarding Capacity	2,160 psgr/hr [e]
Max Wait Time	Approx 60 sec [e]
Vehicle in Station Dwell Time	Data unavailable
Average Station Spacing	Data unavailable

INDIVIDUAL SERVICE: [e]

Privacy	Passengers share vehicle.
Transfers	As required
Stops	Trains stop at all stations.
Accommodation	Seated and standing
Comfort	Climate control assumed for outdoor operation
Security	As required
Instruction	Signs and announcements

RELIABILITY & SAFETY:

Fail Safe Features	Door locks; if power failure, trains stop safely.
Fail Operational Features	Redundant propulsion and brakes
Total System Mean Time Before Failure	5,000 hrs
System Restore Time After Failure	15 min
Station Mean Time Before Failure	5,000 hrs
Station Restore Time After Failure	Data unavailable
Vehicle Mean Time Before Failure	5,000 hrs
Strategy For Removal of Failed Vehicle	Data unavailable
Strategy For Passenger Evacuation of Failed Vehicle	Data unavailable
System Lifetime	20 years
Vehicle Lifetime	Data unavailable

MAINTENANCE:

Data unavailable

CARGO CAPABILITY: [a]

Passenger Articles	Small packages and optional luggage racks
Goods Movement	Not provided

PERSONNEL REQUIREMENTS: [e]

Attendant at control; control and maintenance personnel

PHYSICAL DESCRIPTION

TRAIN: [a 71] (See dwg. for car dimension)

Overall Length	40 ft (12192 mm)
Overall Width	5 ft (1524 mm)
Overall Height	7.5 ft (2286 mm)
Empty Weight	7,200 lbs (3265.5 kg)
Gross Weight	13,800 lbs (6258.5 kg)
Passenger Space (Design Load)	4.0 ft^2 (0.37 m^2) seated 2.5 ft^2 (0.23 m^2) standing
Doorway Width	48.0 in (1219.2 mm)
Doorway Height	78.0 in (1981.2 mm)
Step Height	Level

SUSPENSION: [a 71]

Type	Supported by 4 pneumatic tires per articulated bogey, one bogey per joint, air-bag springs
Design Load	Data unavailable
Obstacle Clearance	1.0 ft (0.304 m)
Lateral Guidance	4 lateral pneumatic tired guidewheels constrained to follow center raised guidebeam

PROPULSION & BRAKING: [a 71]

Type & No. Motors	4 continuous duty cycle dc electric motors, traction drive
Motor Placement	One each per bogey
Motor Rating	25 HP
Type Drive	Traction drive
Gear Ratio	Data unavailable
Type Power	Single phase ac power with on-board rectification
Power Collection	Rails on guideway and collector on lead car
Type Service Brakes	Dynamic plus drum brakes
Type Emergency Brakes	Electromechanical shaft brake
Emergency Brake Reaction Time (i.e., time period from first sensing a failure to reaching full rated braking)	Data unavailable

SWITCHING: [a 71]

Type & Emplacement	Two moveable guidebeams actuated by choice of pneumatic, hydraulic, or electric
Switch Time (lock-to-lock)	9 sec
Speed Thru Switch	Line speed straight - approx 5 mph (8 km/hr) curved
Headway Thru Switch	60 sec min

GUIDEWAY: [a 71]

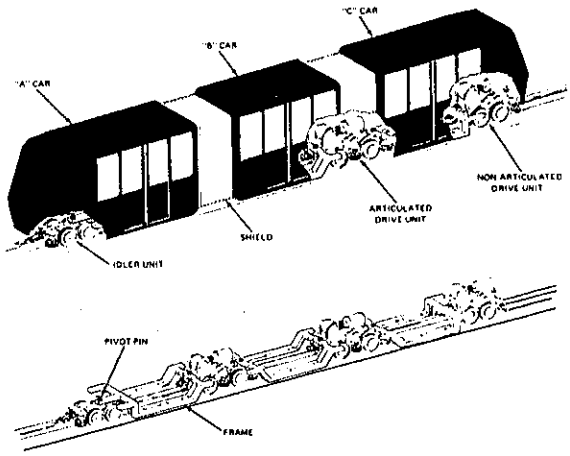
Type	Running surface with center guidebeam
Materials	Concrete surface - steel or aluminum guidebeam
Running Surface Width	5.0 ft (1524 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	Assumed to be at-grade
Overall Cross Section Width	8 in (203 mm) guidebeam only
Overall Cross Section Height	4.75 in (121 mm) guidebeam only
Design Load	Data unavailable
Double Lane Elevated Guideway:	Data unavailable
Guideway Passenger Emergency Egress	Data unavailable
Type Elevated Guideway Support Columns	Data unavailable

CONTROL: [a]

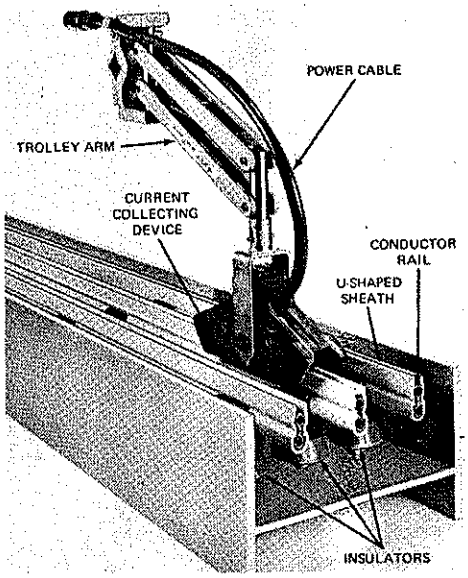
Automatic train operation is standard on a "P" series. Headway control is by fixed-block system. Control options are Train Detection, Automatic Train Separation, Cab Signaling and Overspeed.

STATIONS: [a]

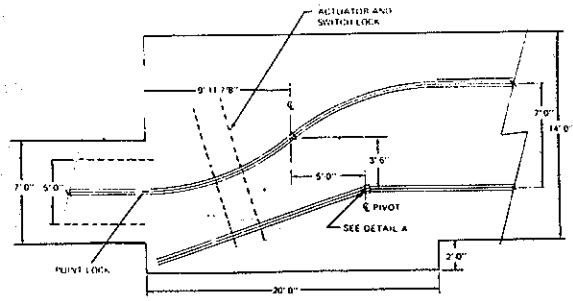
Minimum platform length	– 30 ft (9.14 m) for standard 3 car train
Platform Height	– 6 in (152 mm)
Clearance Height Required	– 8.5 ft (2.59 m)
Clearance Width Required	– 7 ft (2.13 m)



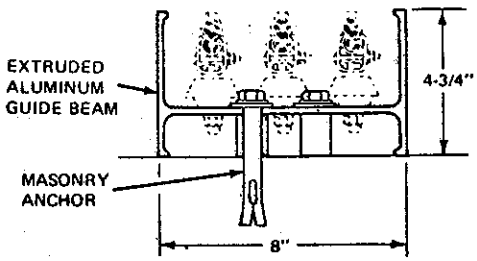
TRAIN MECHANIZATION



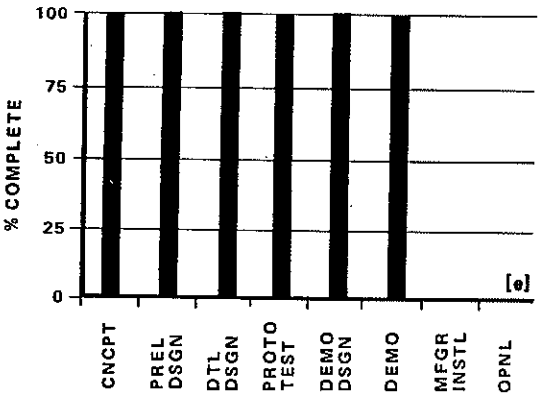
POWER TRANSFER



STANDARD SWITCH LAYOUT



GUIDEBREAM CROSS SECTION



DEVELOPMENT STATUS

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Development history unavailable

INSTALLATIONS & CONTRACTS:

Houston Airport: 1 mi (1.6 km) of single guideway 6 trains of 3 cars each, and 8 stations, Installed in October, 1972

COSTS:

Data unavailable

INSTALLATION OR RETROFIT CAPABILITY: [a: except as noted]

Single Lane Guideway Envelope Width . . . . . 7.0 ft (2133.6 mm)
Single Lane Guideway Envelope Height . . . . . 8.5 ft (2590.8 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 2%
Min Vertical Turn Radius . . . . . 14.5 ft (4.42 m)
Min Horizontal Turn Radius . . . . . Data unavailable
Construction Process . . . . . Prefabricated and modular components, pour-in-place running surface
Staging Capability . . . . . Line and loop sections could be operated as others under construction [e]

LIMITATIONS: [e]

Installations are limited to low capacity short-trip requirements as activity center circulators.

Fixed-block headway control and guideway mounted switch fixes headway.

System must slow to appox 5 mph for 14.5 ft radius turns.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual . . . . . Insufficient data to make assessment
Present guideways are at-grade [e]
Noise . . . . NCA 60 curve applies both inside and outside vehicle [b]

StaRRcar (Self-Transit Rail and Road Car)

CLASSIFICATION: Light Guideway Transit*

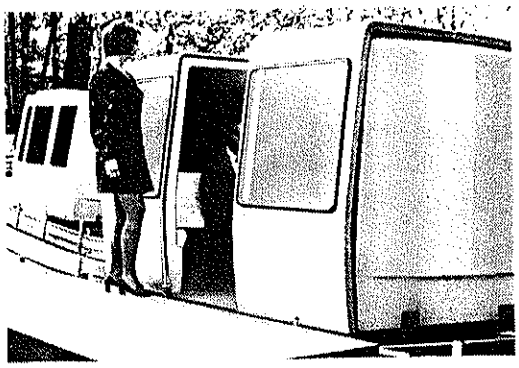
OTHER NAMES: StaRRbus

DEVELOPER: Alden Self-Transit Systems Corporation
64 Sumner Street
Milford, Massachusetts 01757
U.S.A.
Tel: (617) 478-0500

LICENSEES: (For car mechanical components - nonexclusive)
The Boeing Company
P.O. Box 3999
Seattle, Washington 98124
Tel: (206) 773-3360

PATENTS: U.S.A. Patent Nos: 3,225,704; 3,254,608; 3,363,584, 3,532,060; 3,643,601; 3,263,625; 3,661,093; 3,675,584; 3,681,587; 3,771,119

DATA REFERENCE CODE: [a: except as noted]

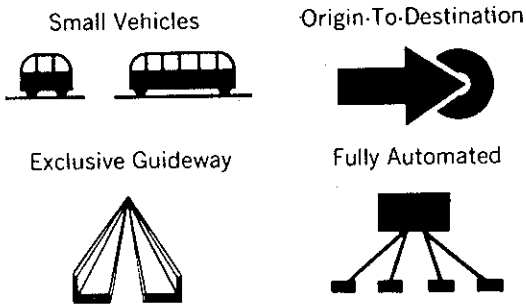


TEST TRACK AND VEHICLE

SYSTEM DESCRIPTION:

StaRRcar is a collection/distribution system for transporting both people and goods in an area, along a line, or around a loop. The system is totally automated, operating rubber-tired electrically propelled vehicles over exclusive guideways between off-line stations. Service is on-demand and vehicles travel non-stop between origin and destination stations. A unique active steering mechanism is employed which steers the vehicle along either the left or right dependent upon the desired path. This steering mechanism is proposed to be adapted to conventional automotive vehicles thereby, making them dual-mode.

Passengers entering the station, pass through an automated ticketing/fare collection machine and go directly to the loading platform, as directed by computer controlled graphics and displays. In the event no vehicle is waiting a "call" button is pushed to summon a vehicle. An "open" button on the car opens the vehicle. Once the passenger is aboard the vehicle he selects the destination on a push button panel.

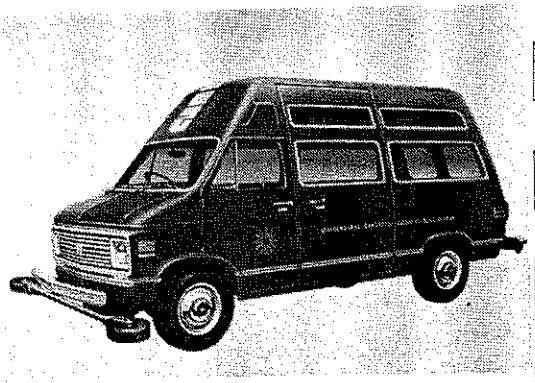


SYSTEM CHARACTERISTICS

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE: [a 21]

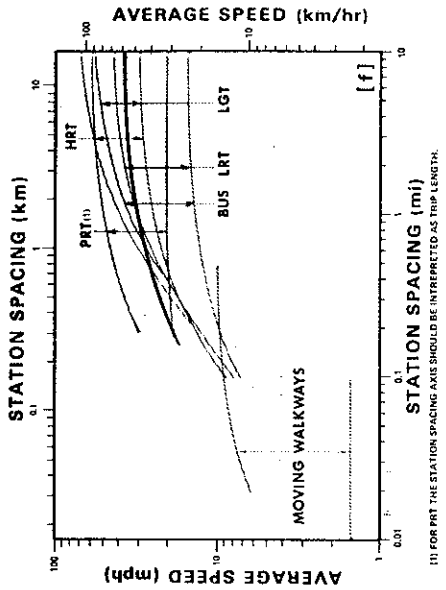
Max Theoretical One-Way Capacity	12,000 psgr/hr (10 psgr veh)
Max Practical One-Way Capacity	9,600 psgr/hr
Min Theoretical Headway	3 sec
Min Practical Headway	3.6 sec
Availability	On-demand, 24 hrs/day
Type Service	Limited area collection and distribution
Type Network	Linear, loop or area networks
Type of Vehicle Routing	Variable routes
Traveling Unit	Single vehicles

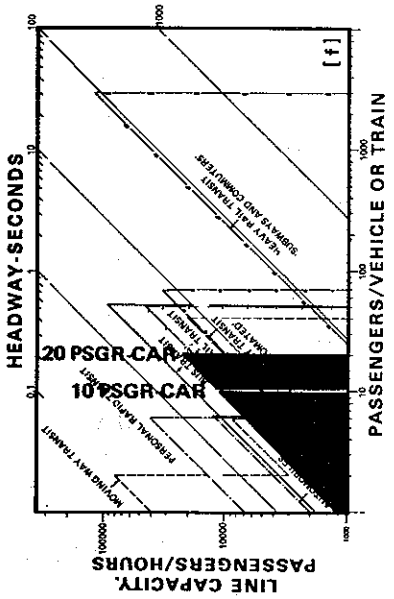


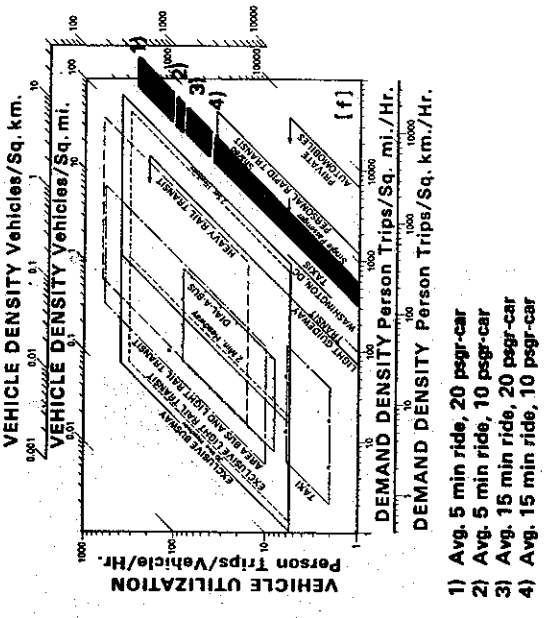
DUAL MODE VERSION

**PUBLISHER'S NOTE:*

StaRRcar has been classified as LGT because the system herein reported offers 10 or 20 passenger vehicles suggesting shared rides. The developer proposes 4-passenger vehicles as well which would classify such a system as PRT.







VEHICLE PERFORMANCE: [a 51]

Cruise Velocity	30 mph (48 km/h)
Max Velocity	Data unavailable
Max Grade	10%
Service Acceleration	3.2 ft/s^2 (0.98 m/s^2)
Service Deceleration	3.2 ft/s^2 (0.98 m/s^2)
Max Jerk	3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel	9.7 ft/s^2 (2.9 m/s^2)
Stopping Precision in Station	±3 in (±76 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & snow	Ice and snow would be melted
Vehicle Design Capacity	6 or 10 seated 4 or 10 standing
Vehicle Crush Capacity	6 or 10 seated 6 or 13 standing
Energy Consumption	2 - 3 kwh/veh-mi (1.24 - 1.86 kwh/veh-km)

STATIONS:

Type	Off-line
Type Boarding	Level
Ticket or Fare Collection	Automatic ticket/fare machines
Security	Closed circuit TV; possibly attendants
Boarding Capacity	Approx 2,400 psgr/hr/berth
Deboarding Capacity	Approx 2,400 psgr/hr/berth
Max Wait Time	Dependent upon system configuration
Vehicle in Station Dwell Time	15 - 25 sec
Average Station Spacing	0.1 - 0.95 mi (0.152 - 1.520 km)

INDIVIDUAL SERVICE: [a 21]

Privacy	Passengers share compartments.
Transfers	Not required
Stops	Non stop
Accommodation	Seated and standing
Comfort	Air conditioned
Security	TV, alarm button, possibly station attendant
Instruction	Active and passive station and car displays

RELIABILITY & SAFETY: [a 21]

Fail Safe Features . . . . . Passenger's safety is insured at:
- unexpected stop or overspeed of car
- computer and wayside hardware failures

Fail Operational Features	Depends on requirements
Total System Mean Time Before Failure	Data unavailable
System Restore Time After Failure	2 - 5 min
Station Mean Time Before Failure	Data unavailable
Station Restore Time After Failure	Data unavailable
Vehicle Mean Time Before Failure	Data unavailable
Strategy For Removal of Failed Vehicle	Pushing by other vehicle or special removal vehicle
Strategy For Passenger Evacuation of Failed Vehicle	Evacuated as failed vehicle is removed
System Lifetime	Data unavailable
Vehicle Lifetime	Data unavailable

MAINTENANCE:

Maintenance facility includes outside parking of reserve vehicles, automatic vehicle checkout and washing, and a separate repair and overhaul building.

CARGO CAPABILITY:

Passenger Articles	Baggage racks, small packages, wheelchairs [e]
Goods Movement	Passenger cab removed from chassis and replaced with freight container

PERSONNEL REQUIREMENTS:

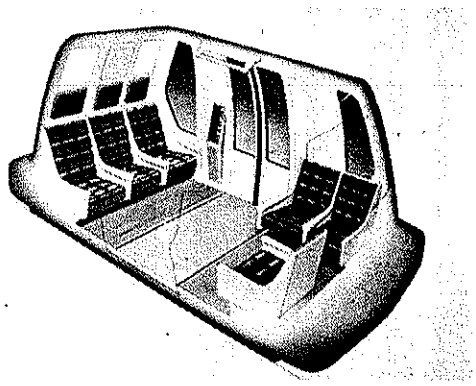
Typical System of 100 vehicles, 6 stations and 8 mi (12.9 km) of one-way guideway

No. of Operators/Vehicle	None
No. of Attendants/Station	1 recommended
No. of Central Control Attendants	2/8 hrs
No. of Maintenance Personnel	6
Engineering Staff	3

PHYSICAL DESCRIPTION

VEHICLE: [a 51]

Overall Length	12.5 ft (3810 mm) 10 psgr 14.1 ft (4298 mm) 20 psgr
Overall Width	6.7 ft (2042 mm) 10 or 20 psgr
Overall Height	9.0 ft (2743 mm) 10 or 20 psgr
Gross Weight	7,518 lbs (3410.1 kg) 10 psgr 9,971 lbs (4522.8 kg) 20 psgr
Empty Weight	6,108 lbs (2770.5 kg) 10 psgr 6,371 lbs (3162.0 kg) 20 psgr
Doorway Width	36 in (914 mm)
Doorway Height	60 - 84 in (1524 - 2134 mm)
Step Height	Level



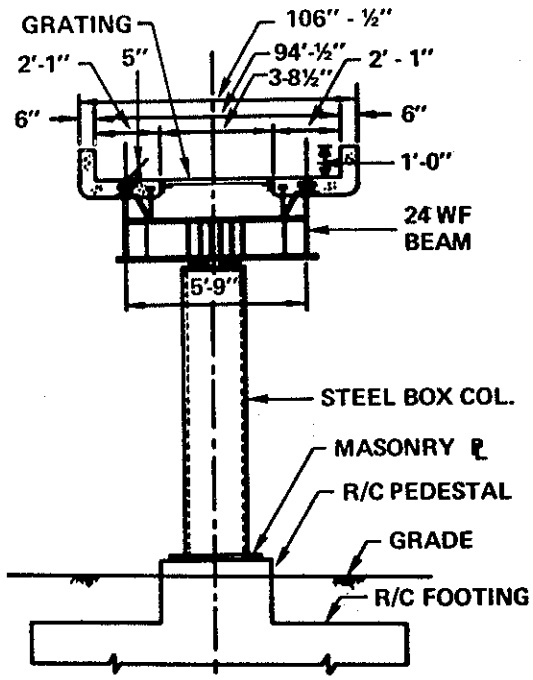
TYPICAL 10-PASSENGER VEHICLE

SUSPENSION: [a 51]

Type	Automotive - 4 pneumatic rubber tires, coil spings and air bags
Design Load	4,500 lbs (2041.2 kg)/front suspension 6,200 lbs (2812.3 kg)/rear suspension
Lateral Guidance	Lateral guidewheels sense left or right sidewalls and actively steer support wheels.

PROPULSION & BRAKING: [a 51]

Type & No. Motors	Asynchronous rotary electric traction motor
Motor Placement	Aboard vehicle
Motor Rating	100 or 125 HP, 74.6 or 93.2 kw at 3,600 rpm
Type Drive	Hydrostatic transmission
Gear Ratio	Variable
Type Power	208 to 575 vac 3ϕ
Power Collection	Two power collectors/vehicle engage power rails, on each side of guideway
Type Service Brakes	Hydraulic drive unit
Type Emergency Brakes	Disk brakes with feedback control
Emergency Brake Reaction Time	Data unavailable



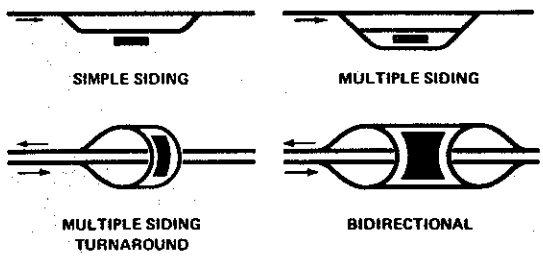
TYPICAL ELEVATED GUIDEWAY STRUCTURE

SWITCHING: [b 51]

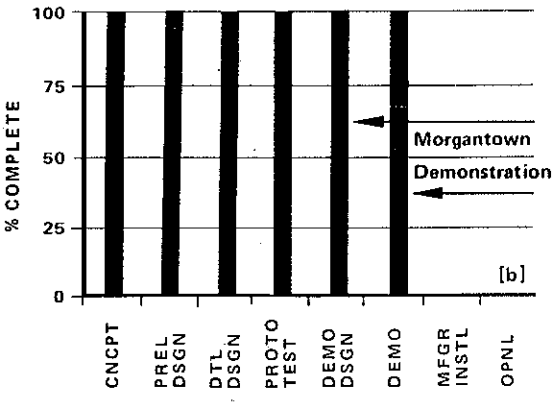
Type & Emplacement	Active steering right or left aboard vehicle
Switch Time (lock-to-lock)	0.2 sec
Speed Thru Switch	30 mph (48 km/h) max
Headway Thru Switch	3 sec min

GUIDEWAY: [a 51]

Type	U-shaped roadway with traction surface
Materials	Steel and/or reinforced concrete
Running Surface With	7.8 ft (2377 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	Typically 70 ft (21336 mm)
Overall Cross Section Width	Approx 9 ft (2743 mm)
Overall Cross Section Height	Approx 2 ft (610 mm)
Design Load	Data unavailable
Double Lane Elevated Guideway:	
Max Elevated Span	Typically 70 ft (21336 mm)
Overall Cross Section Width	Approx 20 ft (6096 mm)
Overall Cross Section Height	Approx 2 ft (610 mm)
Design Load	Data unavailable
Guideway Passenger Emergency Egress	Not provided
Type Elevated Guideway Support Columns	Steel box column



REPRESENTATIVE STATION LAYOUTS



DEVELOPMENT STATUS

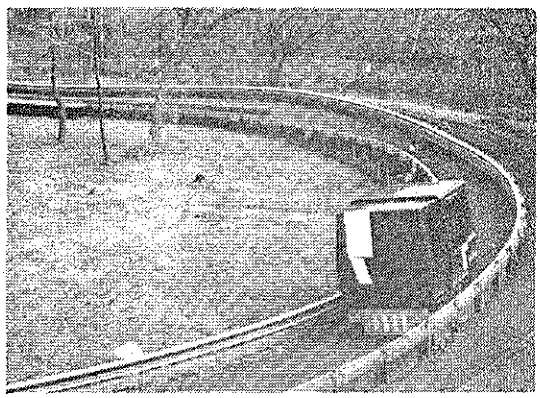
CONTROL: [a 51]

Totally automated hierarch; headway is controlled via synchronous point-follower. Central computer switches and keeps vehicles in assigned slots by transmitting commands via wayside inductive loop antennas. On-board transmitter sends vehicle status and position data upon command via wayside inductive loops. Independent fixed-block collision avoidance system activates emergency brakes of vehicle should headway fall outside set tolerance.

STATIONS:

Variety of station designs offered:

- Simple siding
- Multiple siding
- Multiple siding with turnaround
- Bidirectional Multiple siding with turnaround



PROTOTYPE TEST FACILITY

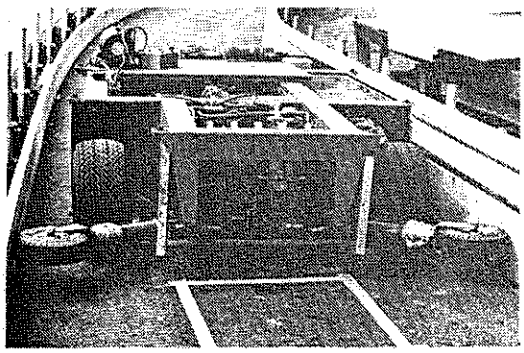
DEVELOPMENT HISTORY, PLANS & PROGRESS:

The system was originally conceived as dual-mode in 1962. The control system was demonstrated via 1/24th scale model in 1968. Prototype test facility was completed at Alden facility in 1970 totally funded by stockholder investment ($1.5 million). The Morgantown vehicle is essentially the Alden design (i.e., steering, propulsion, power collector) under subcontract to the Boeing Company. The Morgantown control system also embodies control philosophies similar to the Alden System. [e]

INSTALLATIONS & CONTRACTS:

Test tract at Alden Facility in Bedford, Massachusetts, 500 ft (152 m) is an at-grade single guideway loop with two stations and two prototype vehicles.

- Proposal — Kennedy International Airport, New York
- Proposal — Morgantown, West Virginia Demonstration
- Proposal — Transpo '72 Demonstration
- Proposal — Ontario Demonstration at CNE
- Proposal — Toronto Zoo



PROTOTYPE VEHICLE CHASSIS UNIT

COSTS:

Capital . . . . . .$3-10 million/one-way mi dependent upon number of vehicles and size and number of stations

Operational / Maintenance . . . . . Typically, 20 cents/veh-mi (12 cents/veh-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . .Approx 9 ft (2743 mm)
Single Lane Guideway Envelope Height . . . . . .Approx 12 ft (3658 mm)
Single Lane Guideway Structural Weight . . . . . 350 lbs/ft (521 kg/m)
Double Lane Guideway Structural Weight . . . . . 675 lbs/ft (1,004 kg/m)
Max Grade 10%
Min Vertical Turn Radius . . . . . .Depends on comfort limits
Min Horizontal Turn Radius . . . . . .Typically 30 ft (9.1 m)
Construction Process . . . . . .Prefabricated guideway is assembled on-site.
Staging Capability . . . . . .Sections can be built and operated as others constructed. Stations and vehicles can be added at will.

LIMITATIONS:

Snow and ice removal must be incorporated if climatic conditions require [b]. Allowance of standees limits service accel/decel to approx 4.4 ft/s^2 (1.34 m/s^2) [e]. Fixed-block collision avoidance system fixes min headway [e].

ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emission [e]
Visual, Single Lane Elevated Guideway . . . . . .[f]
H_1 – 2 ft (610 mm), H_2 – 10 ft (3048 mm)
W_1 – 8.9 ft (2713 mm), W_2 – 8.9 ft (2713 mm)
P_1 – 7.7 ft (2347 mm), P_2 – 12.6 ft (3840 mm)
Noise . . . . . .Will depend upon specific requirements [b]

TRANSURBAN

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Krauss-Maffei AG
Transport System Division
D-8000 München 50
Krauss-Maffei-Strasse 2
West Germany
Tel: 089/8 89 91
Telex: 05/23163

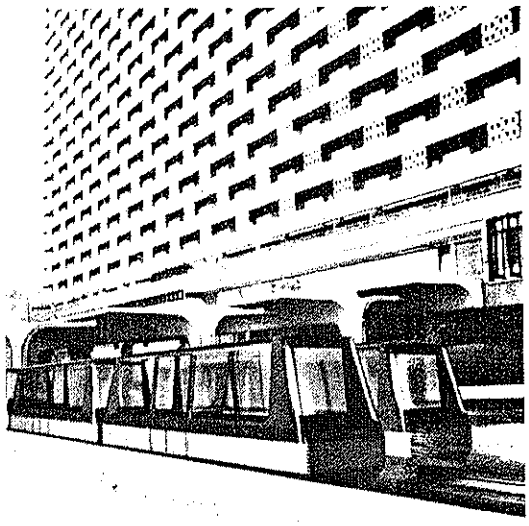
LICENSEES: Data unavailable

PATENTS: Data unavailable

DATA REFERENCE CODE: [a: except as noted]

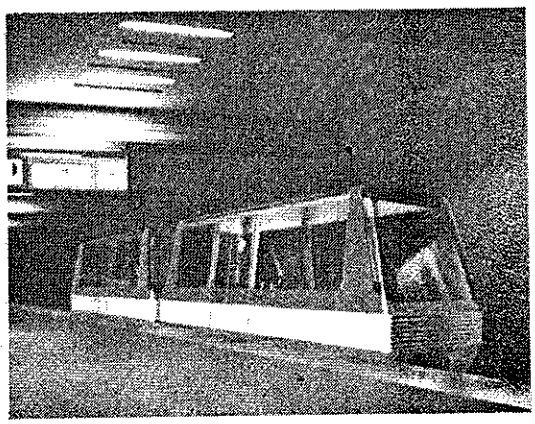
SYSTEM DESCRIPTION:

The Krauss-Maffei Transurban is a Light Guideway Transit system with full automatic operation of individual vehicles or trains of vehicles magnetically suspended above the guideway and propelled electrically. The control system permits headways of 30 to 60 seconds. At peak periods trains of vehicles might move on the same route, where during low periods single or double vehicles operate. Special freight vehicles for the transport of goods during low periods are available. In less densely populated areas the trains are automatically decoupled and, going back to town, are recoupled into trains. The electronic control system was developed by Standard Elektrik Lorenz A.G.



AT-GRADE INSTALLATION

ABOVE-GRADE INSTALLATION



UNDERGROUND INSTALLATION

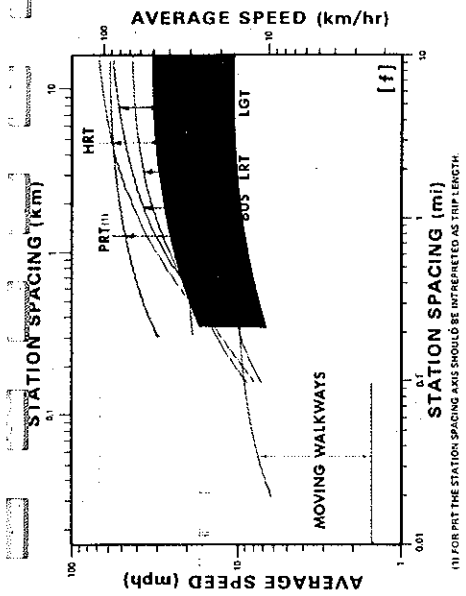
OPERATIONAL CHARACTERISTICS

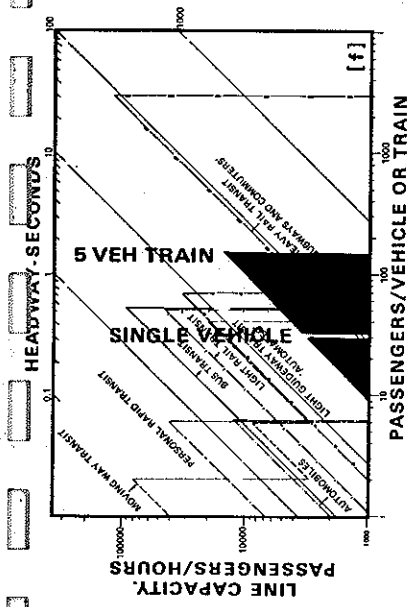
SYSTEM PERFORMANCE:

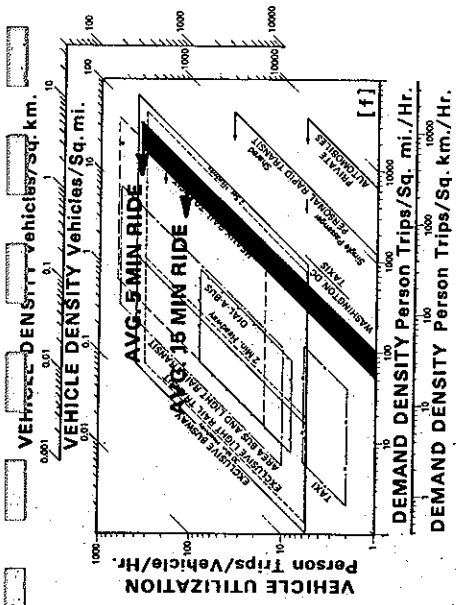
Max Theoretical One-Way Capacity	20,000 psgr/hr
Max Practical One-Way Capacity	16,000 psgr/hr [f]
Min Theoretical Headway	30 sec
Min Practical Headway	36 sec [f]
Availability	Normally on fixed schedules [e]
Type Service	Limited area point-to-point and/or collection and distribution
Type Network	Complex network possible, normally line-haul or loop [e]
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicles or trains

VEHICLE PERFORMANCE:

Cruise Velocity	10.6 - 31.1 mph (17 - 50 km/h)
Max Velocity	49.7 - 74.5 mph (80 - 120 km/h)
Max Grade	10 - 15%
Service Acceleration	4.92 ft/s^2 (1.5 m/s^2)
Service Deceleration	4.92 ft/s^2 (1.5 m/s^2)
Max Jerk	2.62 ft/s^3 (0.8 m/s^3)
Emergency Decel	9.84 ft/s^2 (3.0 m/s^2)
Stopping Precision in Station	Data unavailable
Degradation if Guideway is Wet	Same as clear
Degradation for Ice & Snow	Same as clear for up to 2/3 in (16:94 mm) ice formation
Vehicle Design Capacity	14 seated 16 standing Vehicles with 6 to 30 seats are possible







STATIONS:

Type . . . . . .On-line and off-line at, below or above-grade
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Any type of fare-paying system
Security . . . . . Voice communication between operating control center and individual vehicles or all the vehicles in a specific guideway section is possible as well as between the operating control center and the stations.
Boarding Capacity . . . . . 2,500 psgr/hr/berth
Deboarding Capacity . . . . . 2,500 psgr/hr/berth
Max Wait Time . . . . . .Normally 30 to 60 sec
Vehicle in Station Dwell Time . . . . . 15 sec
Average Station Spacing . . . . . 0.37 mi (0.6 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . .Generally not necessary
Stops . . . . . Yes, but limited if off-line stations
Accommodation . . . . . Seated and standing
Comfort . . . . . Heating and air conditioning
Security . . . . . Central voice communications
Instruction . . . . . Signs indicating where vehicles for various routes stop

RELIABILITY & SAFETY:

Fail Safe Features . . . . . The on-board automatic vehicle control unit operates on batteries in case of power failure. Also emergency brakes and cabin doors stay operational in case of power failure.
Fail Operational Features . . . . . .The control and communication system is not affected by local breakdowns.

Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
Strategy For Removal of Failed Vehicle
System Lifetime
. . . . . Data unavailable

MAINTENANCE:

By using electromagnets for suspension and guidance functions and LIM for propulsion, wear is reduced substantially.

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages & hand luggage, child carts and wheelchairs [b]
Good Movement . . . . . Special freight vehicles

PERSONNEL REQUIREMENTS: [e]

Vehicles do not require drivers. Personnel are required only for supervision at the central control facility, for maintenance, and possibly as station attendants.

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 24.61 ft (7500 mm)
Overall Width . . . . . 6.56 ft (2000 mm)
Overall Height . . . . . 10.5 ft (3200 mm)
Empty Weight . . . . . 19,800 lbs (9000 kg)
Gross Weight . . . . . 25,300 lbs (11500 kg)
Passenger Space (Design Load) . . . . . .Data unavailable
Doorway Width . . . . . 39.37 in (1000 mm)
Doorway Height . . . . . .Data unavailable
Step Height . . . . . Level

SUSPENSION:

Type . . . . . Suspended by attractive electromagnets attached to the bottom of vehicles. Electromagnetic field regulated by an active electronic control system. Air gap 0.4 to 0.6 in (16-25 mm)
Design Load . . . . . Data unavailable
Lateral Guidance . . . . . .Guidance with same magnets as suspension

PROPULSION & BRAKING:

Type & No. Motors . . . . . .One linear induction motor
Motor Placement . . . . . Mounted horizontally beneath vehicles
Motor Rating . . . . . 402.3 HP, 300 kw
Type Drive . . . . . Linear induction motor
Gear Ratio . . . . . Not applicable
Type Power . . . . . .600 vdc, on-board vehicle inverter
Power Collection . . . . . Brush contacts mounted on frame of vehicle and power rails on guideway
Type Service Brakes . . . . . Linear induction motor, dynamic regenerative
Type Emergency Brakes . . . . .Additional mechanical friction brakes
Emergency Brake Reaction Time (i.e., time period from first sensing a failure to reaching full rated braking) . . . . . Data unavailable

SWITCHING:

Type & Emplacement . . . . . Electronmagnetic switching (without moving parts) by selection of the proper air gap sensor on the vehicle, mechanical back up for safety
Switch Time (lock-to-lock) . . . . . Data unavailable
Speed Thru Switch . . . . . 30 mph (48 km/h) max
Headway Thru Switch . . . . . Data unavailable

GUIDEWAY:

Type . . . . . .Above, at, or below-grade
Materials . . . . . Reinforced concrete or steel with armature rail
Running Surface Width . . . . . 2.46 ft (750 mm)
Single Lane Elevated Guideway: (beam only)
Max Elevated Span . . . . . 115 ft (35000 mm)
Overall Cross Section Width . . . . . 4.8 ft (1464 mm)
Overall Cross Section Height . . 3.61-4.92 ft (1100-1500 mm)
Design Load . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . .Safety path between double tracks
Type Elevated Guideway Support Columns . . . . . .Concrete or steel

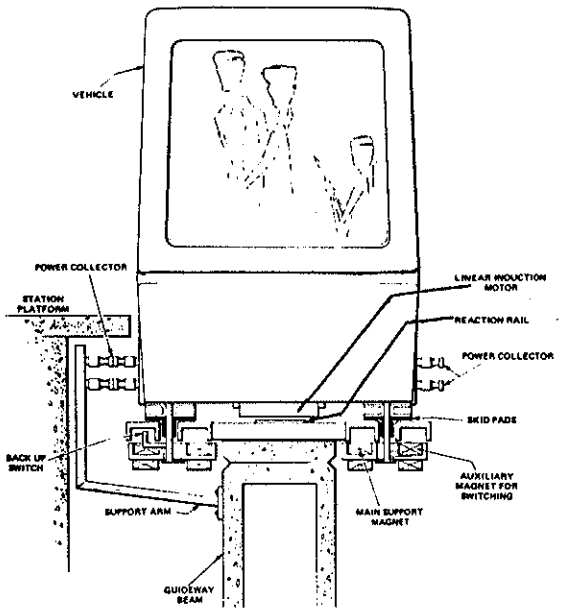
CONTROL:

Fully automatic control is hierarchically organized. A central operation control unit controls the overall and network operation. Lower level remote control units exercise immediate control functions for vehicle movements within individual sections.

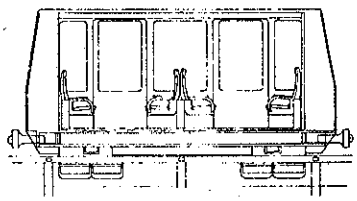
The velocity, train management, and routing control is the same as used on some present German railways and was developed by Standard Elektrik Lorenz.

STATIONS:

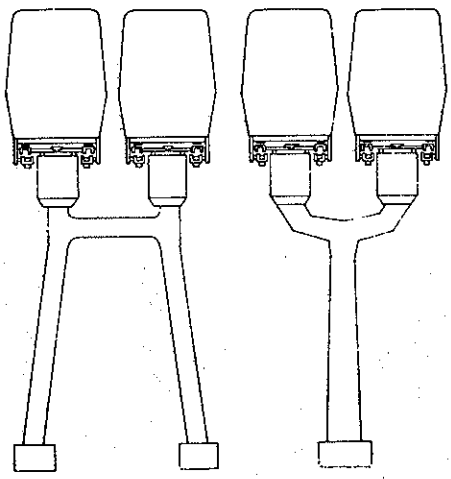
Platforms can be on one or both sides of the vehicles. Length and width depends on capacity requirements. Station may be off-line and at a different level. Stations are provided with air conditioning and TV monitoring.



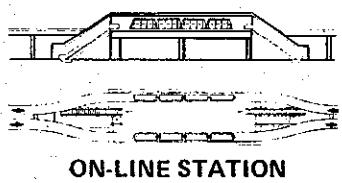
VEHICLE/GUIDEWAY CROSS SECTION



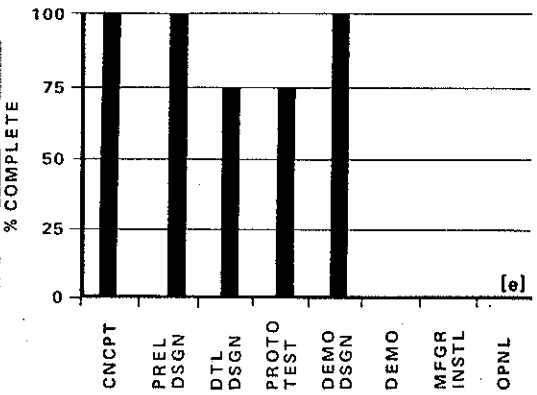
VEHICLE CROSS SECTION SIDE VIEW



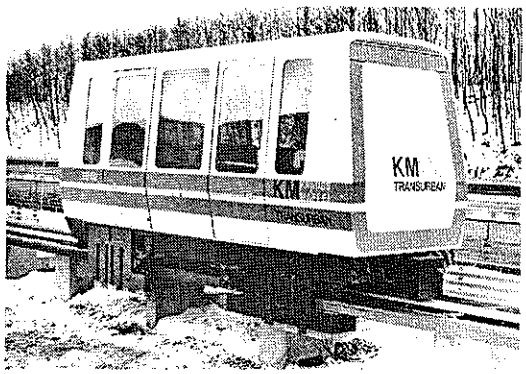
ELEVATED DOUBLE GUIDEWAY IN H AND Y FORM



ON-LINE STATION



DEVELOPMENT STATUS



PROTOTYPE VEHICLE

DEVELOPMENT HISTORY, PLANS & PROGRESS:

A full-scale test vehicle had been under test on a 600 ft (185 m) track in Munich since February, 1973, and had been extended to 3,281 ft (1000 m). A contract had been received from the Province of Ontario, Canada, for installation of a demonstration system at the Canadian National Exhibition (C.N.E.) grounds in Toronto. The provincial government had exclusive rights for the sale of the system in Canada. Expectations by the Ontario provincial government were that installations resulting from the Canadian demonstration would run as high as $5.8 billion [e].

This contract was terminated with mutual consent in 1974 due to a shift in transportation policies in Germany, developer is now cooperating with Messerschmitt-Boelkous Blohm (MBB), Germany, in the development of a high-speed long distance transportation system using the magnetic levitation technology of TRANSRAPID.

INSTALLATIONS & CONTRACTS:

The first installation for $16 million was under construction at the Toronto, Canada C.N.E. to include 2.5 mi (4 km) loop of guideway, 15 vehicles, and 4-off line stations. System was to be operational in the summer of 1975.

A revenue system with a 2.5 and 21 mile network has been studied for Heidelberg, Germany. [b]

COSTS:

Capital . . . . . $7 million/mi ($4.35 million/km) of double guideway including stations and other facilities (Estimates for the 56 mile system in Tornoto) without vehicles. $92,500 per vehicle (1974)

Operational . . . . . 1 cent/psgr-mi
Maintenance (0.62 cents/psgr-km) [b]

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 8.5 ft (2590 mm)
Single Lane Guideway Envelope Height . . . . . 16 ft (4880 mm)
Single Lane Guideway Structural Weight (for single beam only) . . . . . 1,005 lbs/ft 1500 kg/m)
Double Lane Guideway Structural Weight (for double beam only) . . . 2,010 lbs/ft (3000 kg/m)
Max Grade . . . . . 10 (-15)%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 98.4 ft (30 m) at 12 mph (19.3 km/h)
Construction Process . . . . . Prefabricated guideway beams
Staging Capability . . . . . Sections could be installed and operated while others are under construction. [e]

LIMITATIONS: [e]

Permittance of standees limits acceleration/deceleration to approximately 4.5 ft/s^2 (1.37 m/s^2).

Minimum headway of 30 sec limits single one-way line capacity to 3,600 psgr/hr for single vehicles; therefore, trains of up to 6 vehicles are required to achieve capacity of 20,000 psgr/hr.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct pollution emissions
Visual, Single Lane Elevated Guideway . . . . . .

H_1 – 5.42 ft (1650 mm), H_2 – 15.02 ft (4580 mm)
W_1 – 4.8 ft (1460 mm), W_2 – 7.22 ft (2200 mm)
P_1 – 6.3 ft (1920 mm), P_2 – 14.6 ft (4450 mm)

Noise . . . . . Data unavailable, expected to be low because of magnetic levitation [e].

TRIDIM AEROTRAIN

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Bertin & Cie
B.P. 3
78370 Plaisir
France
Tel: 462-25-00

LICENSEES: Data unavailable

PATENTS: Data unavailable

DATA REFERENCE CODE: [a 41]

SYSTEM DESCRIPTION:

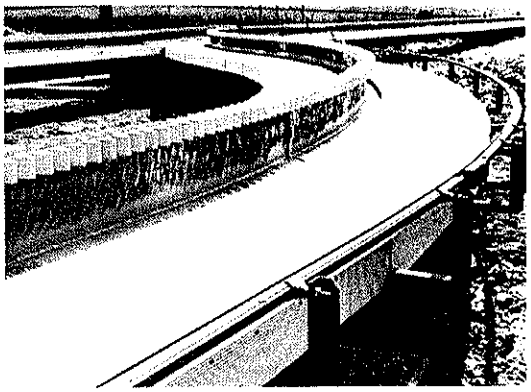
The TRIDIM Aérotrain system is designed to operate in urban areas, adjoining suburbs, or at airports where the distance between stations ranges from a few kilometers down to several hundred meters.

The system consists of small, self-powered, air cushion-suspended vehicles which move on a light-weight, overhead track, which can be mounted on a viaduct. Vehicle capacity can very between 4 and 100 according to requirements. Propulsion is provided by a proprietary rack and pinion system, by rubber-tired traction wheels acting on the center guidance rail, or be linear induction motor, according to customer requirements.

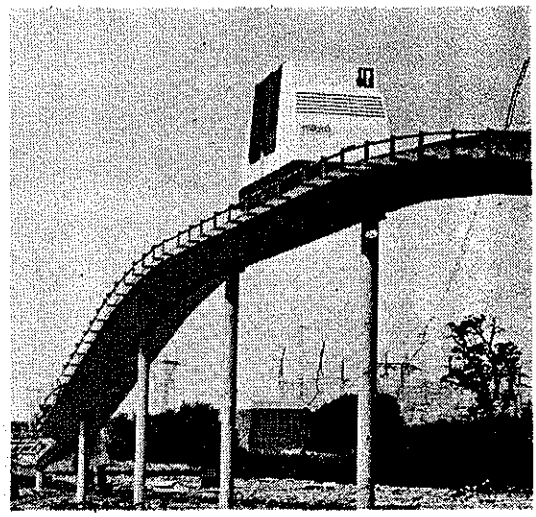
The system can be designed for peak traffic demands of up to 20,000 psgr/hr in each direction.

The TRIDIM vehicle is of modular design and has four identical modules, each accommodating 13 passengers, 9 seated and 4 standing. Each module has one door. The propulsion system is independent from the lifting system. Two vehicles can be coupled and operate as a train accommodating 104 passengers.

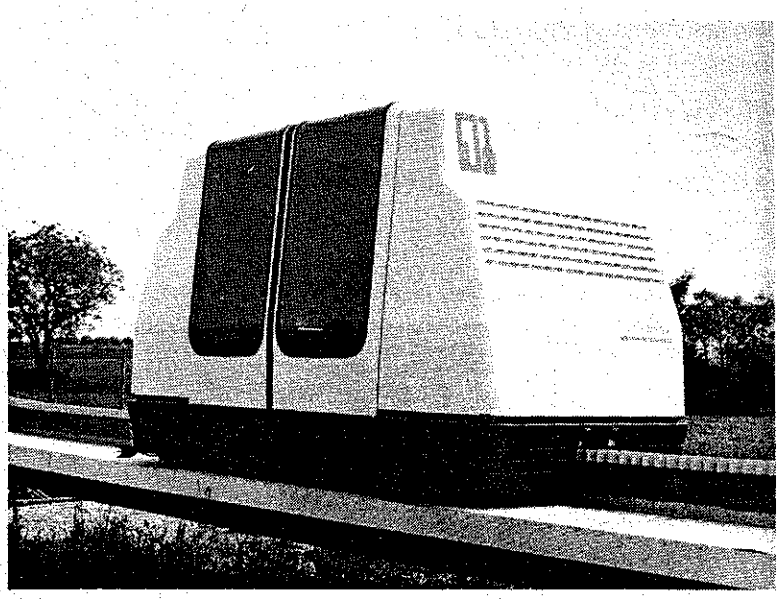
A four-seat prototype vehicle is being tested on a 1,000 foot track which includes a straightaway, grades, curves and a switch.



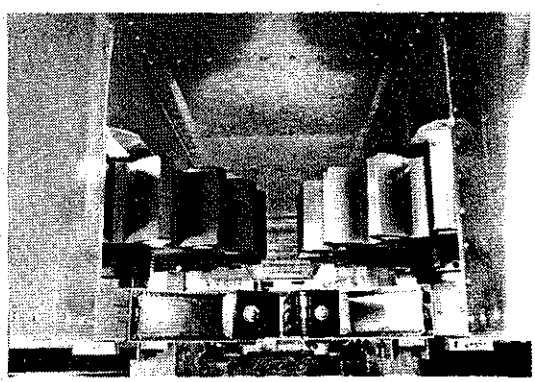
GUIDEWAY WITH RACK AND POWER SIDE-RAIL



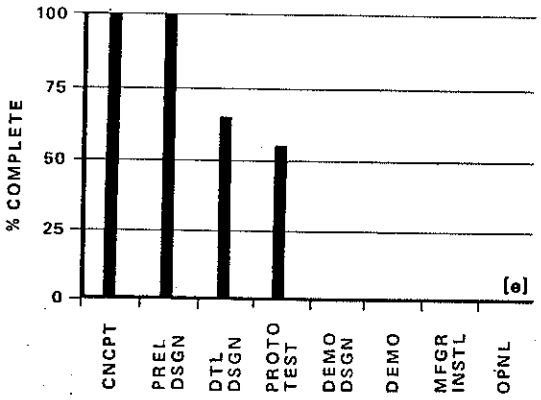
PROTOTYPE VEHICLE ON TEST TRACK



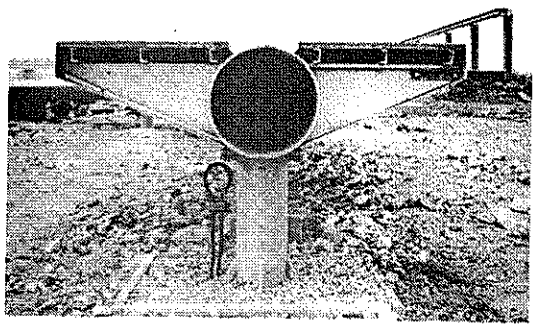
FOUR-SEAT PROTOTYPE VEHICLE



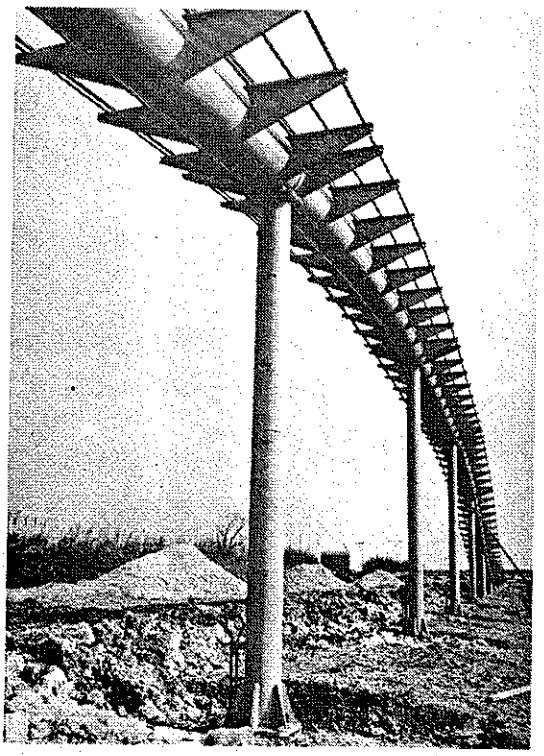
PINION DRIVE



DEVELOPMENT STATUS



GUIDEWAY CROSS SECTION



ELEVATED GUIDEWAY UNDER CONSTRUCTION

OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . Up to 20,000 psgr/hr
Availability . . . . . Scheduled or on-demand
Type Service . . . . . Line-haul or limited area collection & distribution [e]
Type Network . . . . . As required
Type of Vehicle Routing . . . . . Fixed
Traveling Unit . . . . . Single vehicles or vehicle trains

VEHICLE PERFORMANCE:

Cruise Velocity . . . . . Up to 50 mph (80.5 km/h)
Max Velocity . . . . . 65 mph (104.6 km/h)
Max Grade . . . . . 8 - 15%
Service Acceleration . . . . . 3.8 ft/s^2 (1.15 m/s^2)
Service Deceleration . . . . . Data unavailable
Max Jerk . . . . . Data unavailable
Emergency Decel . . . . . 6.4 ft/s^2 (1.96 m/s^2)
Vehicle Design Capacity . . . . . 36 seated 16 standing

PHYSICAL DESICRIPTION

VEHICLE:

Overall Length . . . . . 53.33 ft (16255.0 mm)
Overall Width . . . . . 6.33 ft (1929.4 mm)
Overall Height . . . . . 8.5 ft (2590.8 mm)
Empty Weight [e] . . . . . 13,000 lbs (5895.5 kg)
Gross Weight . . . . . 21,800 lbs (9886.3 kg)

SUSPENSION:

Type . . . . . Air cushion
Lateral Guidance . . . . . The vehicle is guided on this track by means of a low vertical center rail fixed to the surface in line with the vehicle axis. If rack-and pinion propulsion is used, the rack is attached to this rail.

PROPULSION & BRAKING:

Type & No. Motors . . . . . Electro Motors
Motor Placement . . . . . On-board of vehicle
Motor Rating — Propulsion . . . . . 150 kw
Motor Rating — Lifting . . . . . 35 kw
Power Collection . . . . . Side rail
Type Service Brakes . . . . . Electro-dynamic and pads gripping the vertical rail

GUIDEWAY:

Type . . . . . At-grade or elevated
Materials . . . . . Steel
Running Surface Width . . . . . 7.17 ft (2185.4 mm)
Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 66 - 100 ft (20117 - 30480 mm)
- Overall Cross Section Width . . . . . 20.67 ft (6300 mm)
- Overall Cross Section Height . . . . . Data unavailable
- Design Load . . . . . Data unavailable

Guideway Passenger Emergency Egress . . . . . Data unavailable
Type Elevated Guideway Support Columns . . . . . Steel

DEVELOPMENT HISTORY, PLANS & PROGRESS:

Prototype vehicle is being tested.

INSTALLATIONS & CONTRACTS:

The 1,000 ft test track includes a straightaway, grades, curves, a switch and a four-seat prototype vehicle.

INSTALLATION OR RETROFIT CAPABILITY:

Double Lane Guideway Envelope Width . . . . . 20.76 ft (6300 mm)
Double Lane Guideway Envelope Height . . . . . 10.5 ft (3200 mm)
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 15%
Min Horizontal Turn Radius . . . . . 82 ft (25 m)
Construction Process . . . . . Prefabricated

LIMITATIONS: [e]

Vertical guiderail must be moved for switching,limiting headway.

ENVIRONMENTAL IMPACT:

Emissions . . . . . Data unavailable
Noise . . . . . 53 dbA at 24.6 ft (7.50 m) experimental vehicle
70 dbA at 24.6 ft (7.50 m) full size vehicle

UNIFLO

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Uniflo Systems Company
7401 Washington Avenue, South
Minneapolis, Minnesota 55435
U.S.A.
Tel: (612) 941-5000

LICENSEES: None

PATENTS: U.S. Patents are: Pneumatic Propulsion Transportation System 3,242,876; Valve for Levitated Vehicle Track 3,685,788; Valve for Levitated Vehicle Track 3,788,231; Vortex Thruster for Fluid Propelled Objects 3,718,096; Control System for Vehicles Operating on a Track 3,771,463; Pneumatic Suspension System 3,757,699; and Pneumatic Timer 3,786,836; Switch for Vehicle Guideway 3,808,977; Proportional On/off Valve 3,815,866; Proportional Thrust Control for Levitated Vehicles 3,842,746

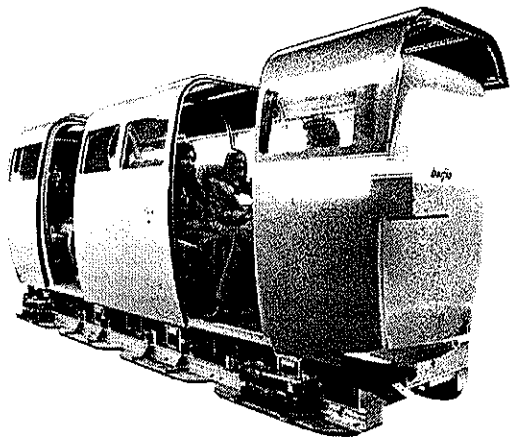
DATA REFERENCE CODE: [a 22, a 41]

SYSTEM DESCRIPTION:

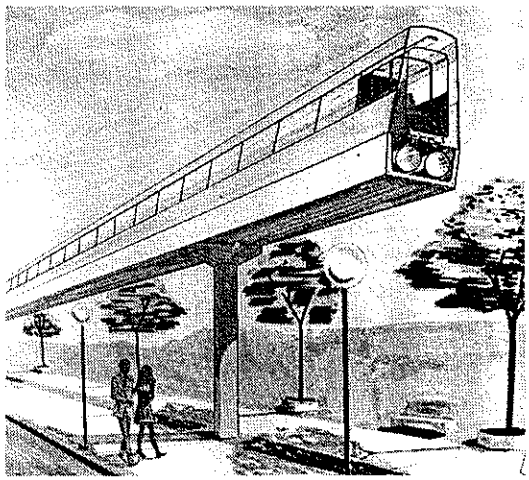
The Uniflo system is a totally mechanically integrated transportation system which utilizes a 2 psi air source to levitate and propel passive vehicles on an exclusive guideway. The totally automatic control system is a track-based pneumatic control that regulates the flow of air from the guideway to the underside of each vehicle, thereby controlling vehicle movement. The system features non-stop service on-demand in 8-12-passenger vehicles from off-line stations. The number of berths in a station is variable, typically ranging between 2 and 8, depending on traffic volume. Entry to the station is via one or more destination selection/fare collection turnstiles. In a flat fare system, the entering passenger selects his desired destination on a push button console listing the destinations serviced from this station (not related to the number of berths). When the fare requirement is met, the passenger proceeds through the turnstile to validate his request. Local station logic then programs any available vehicle to the requested destination, activates an annunciator sign above the berth door that enables the passenger to locate the vehicle providing the service he requested. The sign also displays the time in seconds to departure. Any berth can provide service to any destination. The vehicle leaves its berth after a countdown period which is set to optimize service, seat utilization, or station capacity in terms of traffic flow.

PUBLISHER'S NOTE:

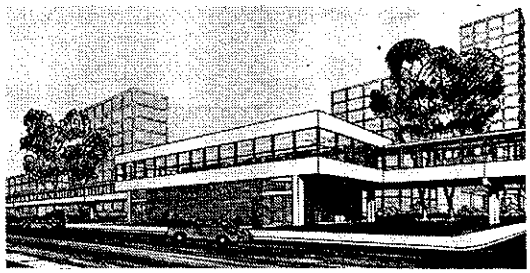
The Uniflo system as reported herein has been classified as LGT because passengers cannot command exclusive use of the vehicle. The developer states that the system could program one vehicle per passenger; however, the capacity would be reduced if vehicles were not operated at fractional second headways. If exclusive service is offered, the system would be classified as PRT according to definition for the Compendium.



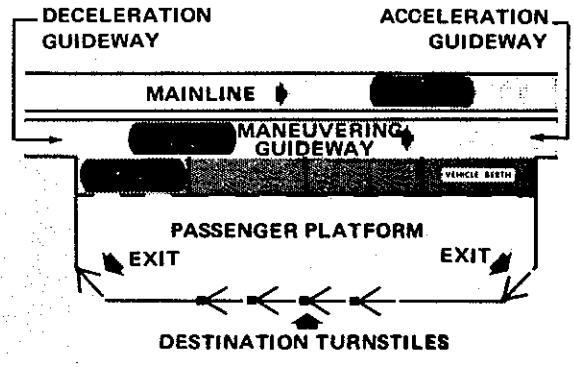
VEHICLE



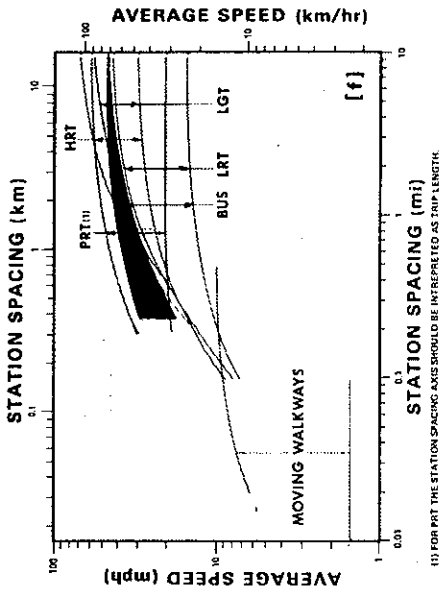
TYPICAL ELEVATED GUIDEWAY

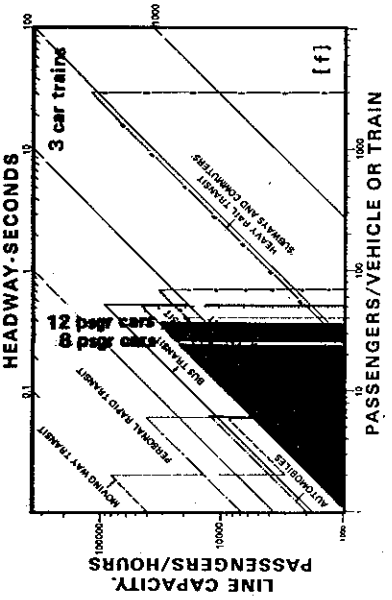


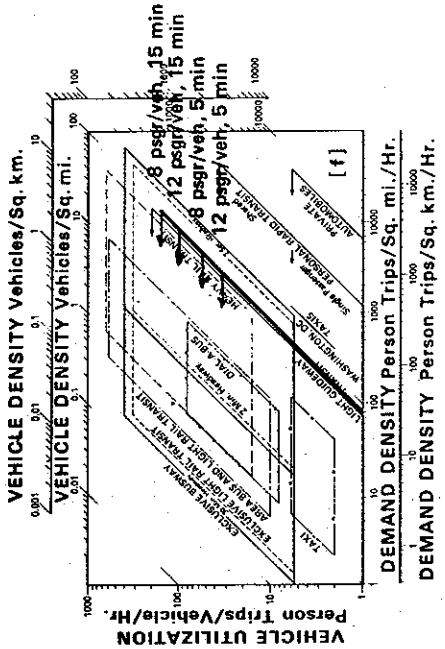
TYPICAL FOUR-BERTH STATION



PLAN VIEW OF FOUR-BERTH STATION







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	9,290 - 35,027 psgr/hr
Max Practical One-Way Capacity	4,320 - 16,904 psgr/hr
Min Theoretical Headway	3.1 sec
Min Practical Headway	4.0 sec
Availability	Scheduled or on-demand
Type Service	Limited area collection & distribution
Type Network	Two-way lines, loop, or area grid
Type of Vehicle Routing	Variable
Traveling Unit	Single vehicle or 2 - 3 car trains

VEHICLE PERFORMANCE:

Cruise Velocity	45 mph (72 km/h)
Max Velocity	50 mph (81 km/h)
Max Grade	10%
Service Acceleration	6.44 ft/s^2 (1.96 m/s^2)
Service Deceleration	6.44 ft/s^2 (1.96 m/s^2)
Max Jerk	6.44 ft/s^3 (1.96 m/s^3)
Emergency Decel	12.88 ft/s^2 (3.96 m/s^2)
Stopping Precision in Station	±0.25 in (6.35 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & Snow	No degradation
Vehicle Design Capacity	8 or 12 seated 0 standing
Vehicle Crush Capacity	8 or 12 seated 0 standing
Energy Consumption, Accelerating and Decelerating Only	
Empty Vehicle	4.57 kwh/veh-mi (2.84 kwh/veh-km)
At Design Capacity	6.53 kwh/veh-mi (4.06 kwh/veh-km)
Energy Consumption, Cruise Only	
Empty Vehicle	1.06 kwh/veh-mi (0.66 kwh/veh-km)
At Design Capacity	1.02 kwh/veh-mi (0.63 kwh/veh-km)

STATIONS:

Type	Off-line parallel berthing
Type Boarding	At, above or below-grade, vertical movement of vehicle in berth permits station platform to be located at a level different than that of guideway
Ticket or Fare Collection	Automated, flat or structured fare system
Security	Closed circuit TV, emergency buttons, two-way intercom
Boarding Capacity	(12 psgr car) 1,440 psgr/hr/berth
Deboarding Capacity	(12 psgr car) 1,440 psgr/hr/berth
Max Wait Time	Variable with system and traffic
Vehicle in Station Dwell Time	30 sec
Average Station Spacing	7.25 mi (11.7 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles.
Transfers	Yes, either passenger or vehicle transfer
Stops	Non-stop per loop or in network
Accommodation	Seated only
Comfort	Air conditioned
Security	Emergency button and intercom
Instruction	Passive and active graphics in stations

RELIABILITY & SAFETY:

Fail Safe Features	Levitation system, propulsion system, switch
Fail Operational Features	Single levitation pad, up to 25% of levitation valves, random failures of track based control components, switch, propulsion elements
Mean Times Before Failures	Data unavailable: however, valve lifetime of 16 million cycles tested. Airpad lifetime of 40,000-50,000 mi.
Strategy For Removal of Failed Vehicle	Retrieval by service vehicle
Strategy For Passenger Evacuation of Failed Vehicle	Manually open doors (which are locked if vehicle is levitated) and exit system via guideway walkway
System Lifetime	30 years
Vehicle Lifetime	20 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed)	
Guideway	0.20 hrs every 1 day/1 mi (1.6 km)
Station	0.25 hrs every 1 day
Vehicle	0.10 hrs every 1 day
Periodic Maintenance	
Guideway	1 hrs every 1 day/1 mi (1.6 km)
Station	1 hrs every 1 day
Vehicle	0.17 hrs every 1 day

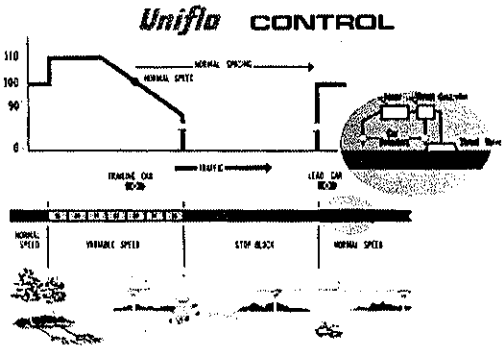
Adjustments Required . . . . . Check vehicle levitation pads, door operation, HVAC system
Other Maintenance . . . . . Check guideway levitation valves, turbines, switches and controls

CARGO CAPABILITY:

Passenger Articles . . . . . Small packages and luggage space under seats
Goods Movement . . . . . Cargo vehicles can operate in a mix with passenger vehicles.

PERSONNEL REQUIREMENTS:

Typical System of 120 vehicles, 18 stations and 6 mi (9.7 km) of one-way guideway
No. of Operators/Vehicle 0
No. of Attendants/Station 0
No. of Administrative Personnel 4
No. of Central Control Attendants . . . . . 6/24 hrs
No. of Maintenance Personnel 26
Engineering Staff 2

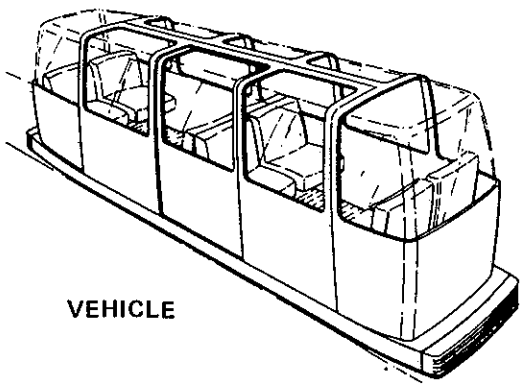


PNEUMATIC HEADWAY CONTROL

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 18.5 ft (5639 mm)
Overall Width . . . . . 3.83 ft (1167 mm)
Overall Height . . . . . 6.5 ft (1981 mm)
Empty Weight . . . . . 2,100 lbs (955 kg)
Gross Weight . . . . . 3,700 lbs (1682 kg)
Passenger Space (Design Load) . . . . . 56 ft^2 (5.2 m^2) seated
Doorway Width . . . . . 28 in (711 mm)
Doorway Height . . . . . Open-door extends over top of vehicle
Step Height . . . . . Level



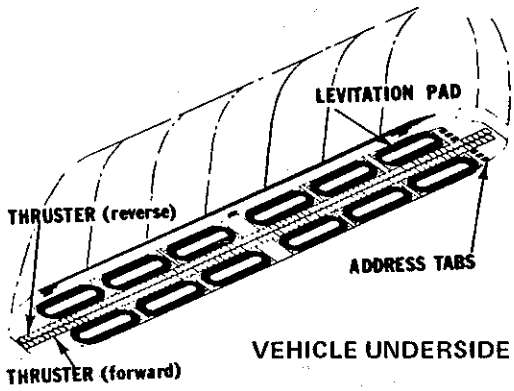
VEHICLE

SUSPENSION:

Type . . . . . Passive air pads under vehicle receive 2 psi air supply from track mounted valves.
Design Load . . . . . 1,600 lbs (727 kg)/front suspension
Lateral Guidance . . . . . Constrained by lateral guidewheels on vehicle operating against metal curbs on guideway

PROPULSION & BRAKING:

Type & No. Motors . . . . . Passive fixed turbine blades aboard vehicles
Design Placement . . . . . Blower stations at 1-2 mi (1.6-3.2 km) intervals
Power Distribution . . . . . Air at 2 psi via air duct system under operating surface at guideway
Type Service Brakes . . . . . Reverse thrust
Type Emergency Brakes . . . . . Friction brake skids
Emergency Brake Reaction Time . . . . . 0.18 sec at 40 mph (64.4 km/h)



VEHICLE UNDERSIDE

SWITCHING:

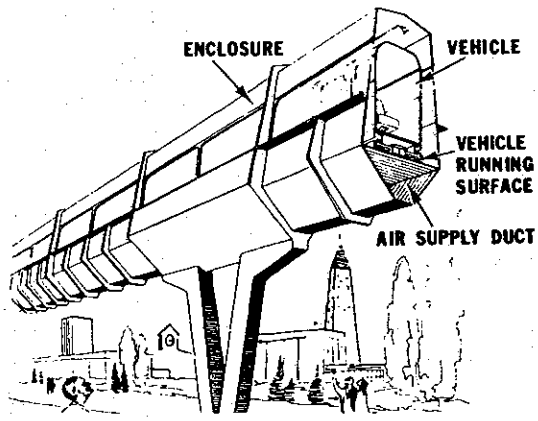
Type & Emplacement . . . . . Track positioned switch wheels on vehicles, moveable and fixed catch rails on guideway
Switch Time (lock-to-lock) . . . . . 0.15 sec
Speed Thru Switch . . . . . 20 - 50 mph (32 - 80 km/h) max
Headway Thru Switch . . . . . 1 sec min

GUIDEWAY:

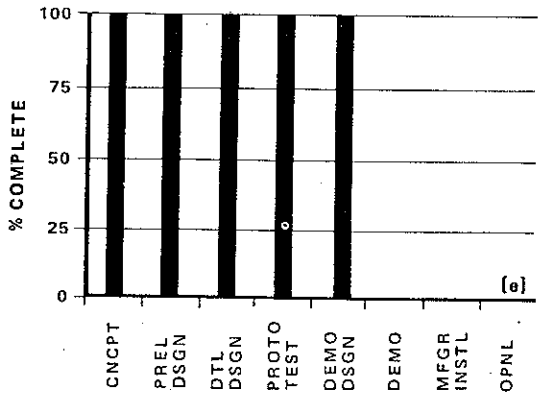
Type . . . . . Enclosed, U-shaped channel running surface
Materials . . . . . Composite reinforced concrete
Running Surface Width . . . . . 4 ft (1.22 m)
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 110 ft (33.5 m)
- Overall Cross Section Width . . . . . 10 ft (3048 mm)
- Overall Cross Section Height . . . . . 13 ft (3962 mm)
- Design Load . . . . . 250 lbs/ft (113.4 kg/m)

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 110 ft (33.5 m)
- Overall Cross Section Width . . . . . 16 ft (4877 mm)
- Overall Cross Section Height . . . . . 13 ft (3962 mm)
- Design Load . . . . . 500 lbs/ft (744 kg/m)

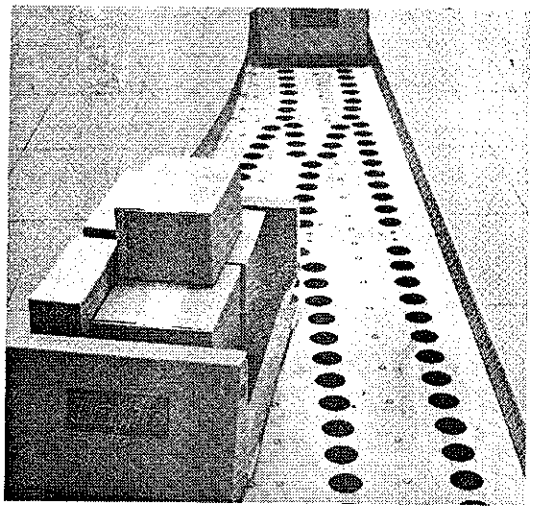
Guideway Passenger Emergency Egress . . . . . Walkway provided in enclosure
Type Elevated Guideway Support Columns . . . . . Steel or concrete



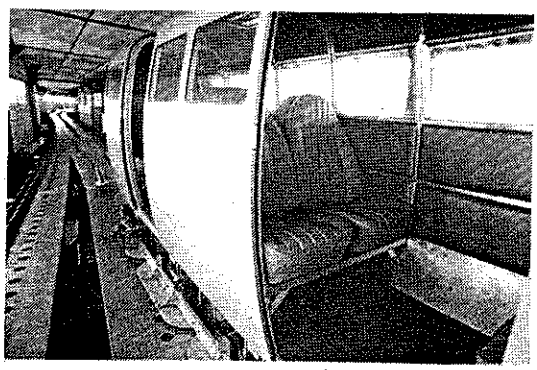
GUIDEWAY



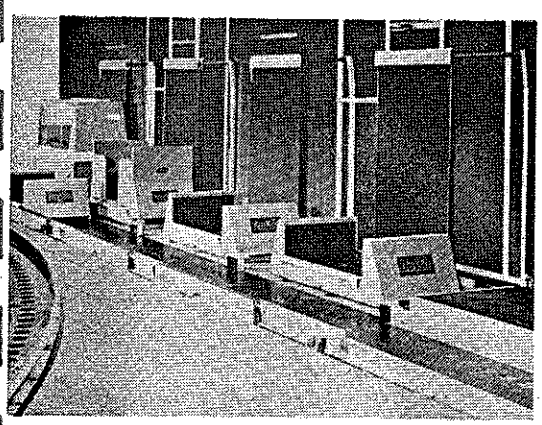
DEVELOPMENT STATUS



BAGGAGE TRANSPORT DEMONSTRATION VEHICLE



INTERIOR OF FULL SCALE TEST FACILITY



ONE-HALF SCALE TEST FACILITY

CONTROL:

A distributed track-based iterative system controls headway (asynchronous fixed-block), vehicle speed, acceleration/deceleration, merging and emergency stopping. Station computers (disital) perform all station logic operations and vehicle destination assignments, accepting nearby track conditions and passenger demands. A central supervisory computer accepts data from station computers and track monitoring units and monitors entire system, displays abnormalities to an operator, performs safety shutdown, vehicle management, and adjusts station berth occupancy policies according to daily and weekly traffic demands.

STATIONS:

Station operation is described under "SYSTEM DESCRIPTION". Size – 3-10 berths, 18 ft (5.5 m) long each, diverge switch and decel guideway length – 220 ft (67 m); accel guideway and merge section length – 220 ft (67 m) for 30 mph (48 km/hr) line speed and 4.7 ft/s^2 (1.43 m/s^2) accel/decel, other lengths based on specified line speeds and accel/decel.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The Uniflo Systems Company is a subsidiary of Rosemont Engineering which began development of the Uniflo system in 1967. In 1969 feasibility was proven and design began.

In 1973 Uniflo Systems Company under contract with the U.S. Department of Transportation completed and placed into operation a 370 ft long enclosed guideway, including a straight section, a spiral, a constant radius turn, and a switch. A full-scale prototype, 8-passenger car is operational on the test tract. Developer states that a full-scale, two-mile demonstration system could be completed in two years.

INSTALLATIONS & CONTRACTS:

Full-scale test facility is under contract to U.S. Department of Transportation. The test track, 370 ft long, is equipped with an 8-passenger car and has been operational since October, 1973.

Proposal – TRANSPO '72 (unsuccessful)
Proposal – Kennedy Airport Access Project
Proposal – Department of Transportation Dual-Mode Program
Proposal – Department of Transportation HPPRT Program

COSTS:

Capital Cost	
Total one-way guideway	– $4.8 million/lane mi ($2.92 million/km)
Four-berth station	– $386,000
Eight-psgr vehicle	– $13,300
Supervisory Control	– $62,000/mi ($38,600/km) + $93,000/station
Blower system	– $64,000/mi ($39,800/km)
Maintenance facility	– $50,000/mi ($31,000/km)
Avg total system cost	– $5.7 million/mi ($3.54 million/km)
Operation and Maintenance Costs	Data unavailable

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	10 ft (3.05 m)
Single Lane Guideway Envelope Height	13 ft (3.96 m)
Single Lane Guideway Structural Weight	726 lbs/ft (1082 kg/m)
Double Lane Guideway Structural Weight	1,100 lbs/ft (1639 kg/m) in steel or 4,000 lbs/ft (5960 kg/m) in concrete
Max Grade	10%
Min Vertical Turn Radius	750 ft (229 m)
Min Horizontal Turn Radius	90 ft (27 m)
Construction Process	Factory manufactured for site erection
Staging Capability	Optional

LIMITATIONS:

Totally enclosed guideway may limit retrofit installation opportunities.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emission

Visual, Single Lane Elevated Guideway . . . . .

H_1 – 13 ft (3962 mm), H_2 – 13 ft (3962 mm)
W_1 – 10 ft (3048 mm), W_2 – 10 ft (3048 mm)
P_1 – 16 ft (4877 mm), P_2 – 16 ft (4877 mm)

Noise . . . . . 65 dbA (NCA 60) inside vehicle
48 dbA (NCA 40) at 25 ft (7.62 m) to side

UNIMOBIL/HABEGGER SYSTEM (TYPE II)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: The sytem is marketed in North America under the name "Unimobil/Habegger System", whereas in Europe the same system carries the name "Minirail".

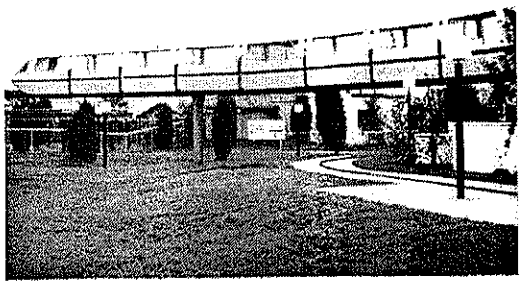
DEVELOPER: Universal Mobility, Inc.
65 West Louise Avenue
Salt Lake City, Utah 84115 U.S.A.
Tel: (801) 487-5611

Habegger Ltd. Engineering Works
Industriestrasse
Thun, Switzerland
Tel: 033-21837/35421

LICENSEES: None

PATENTS: U.S. patents 3,339,494; 3,391,652; 3,359,922; 3,313,234; and 3,352,254

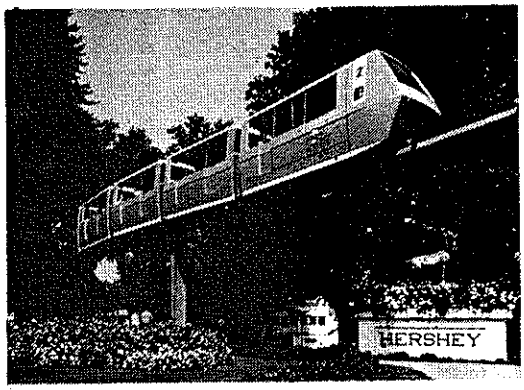
DATA REFERENCE CODE: [a 91]



SYSTEM AT CAROWINDS, NORTH CAROLINA

SYSTEM DESCRIPTION:

The Unimobile/Habegger System is a small monorail transportation system. A relatively large number of small trains operate fully automatically on a guideway loop with off- or on-line stations. Twelve-passenger cars can be coupled together in a train, which can operate at a cruise speed of up to 15 mph. The system is designed for short distance transportation in dense traffic areas with stations every 1,000 to 2,000 feet. Headways of 45 sec can be achieved. The system has been proven with 15 operational installations for parks and exhibitions. Two systems are offered: Type II and Type II-S. Type II is described herein.

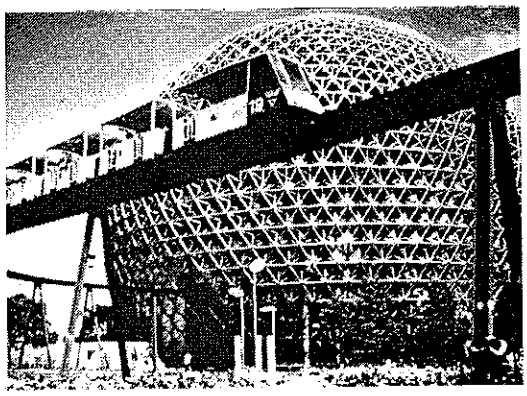


SYSTEM AT HERSHEY PARK, PENNSYLVANIA

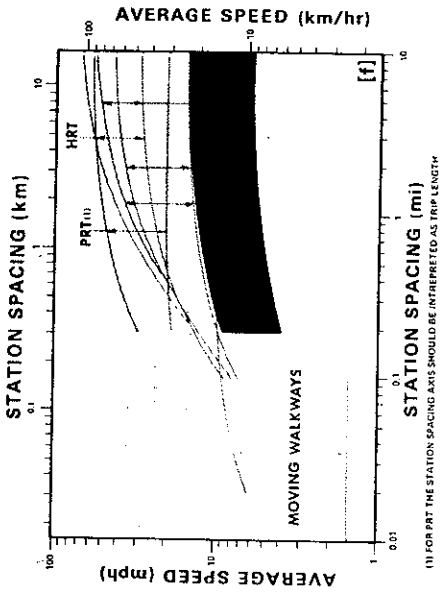
OPERATIONAL CHARACTERISTICS

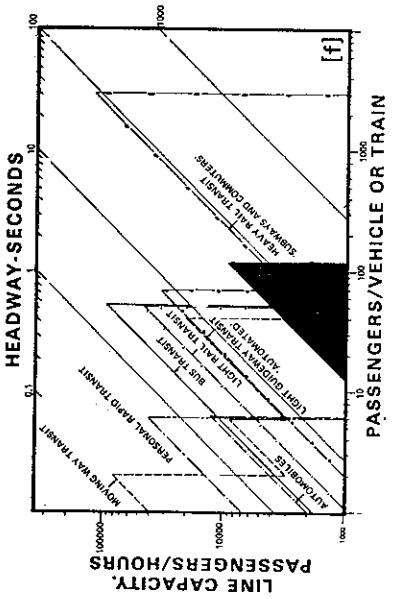
SYSTEM PERFORMANCE:

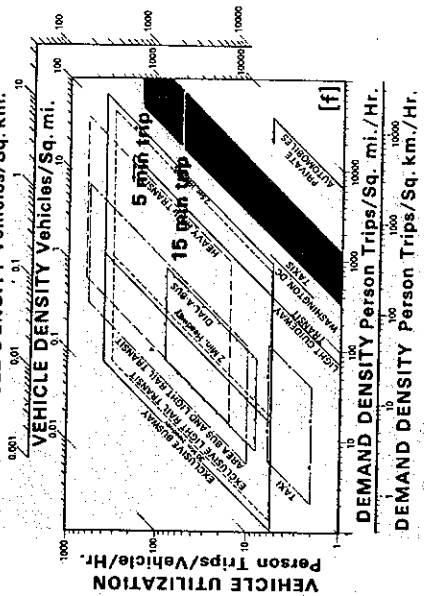
Max Theoretical One-Way Capacity	9,720 psgr/hr
Max Practical One-Way Capacity	8,100 psgr/hr
Min Theoretical Headway	36 sec
Min Practical Headway	45 sec
Availability	Fixed schedule
Type Service	Limited area collection and distribution
Type Network	Loop
Type of Vehicle Routing	Fixed
Traveling Unit	Trains with 5 to 9 cars



SYSTEM AT EXPO '67 MONTREAL, CANADA







VEHICLE PERFORMANCE:

Cruise Velocity	6 to 15 mph (9.6 to 24 km/h)
Max Velocity	15 mph (24 km/h)
Max Grade	8%
Service Acceleration	3.0 ft/s^2 (0.91 m/s^2)
Service Deceleration	3.0 ft/s^2 (0.91 m/s^2)
Max Jerk	6.44 ft/s^3 (1.96 m/s^3)
Emergency Decel	6.44 ft/s^2 (1.96 m/s^2)
Stopping Precision in Station	±3 in (±76 mm)
Degradation if Guideway is Wet	Same as clear
Degradation for Ice and Snow	Same as clear if track is heated
Vehicle Design Capacity	14 seated
Vehicle Crush Capacity	Data unavailable
Energy Consumption	6 kwh/125 psgr train

STATIONS:

Type	On-or off-line
Type Boarding	Level
Ticket or Fare Collection	As required
Security	As required
Boarding Capacity	6,000 psgr/hr
Deboarding Capacity	6,000 psgr/hr
Max Wait Time	60 sec
Vehicle in Station Dwell Time	20 sec
Average Station Spacing	0.2 - 0.4 mi (0.3 to 0.6 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicle
Transfers	As required dependent upon routes
Stops	Stops for other passengers at all stations
Accommodation	Seated and standing
Comfort	Heating air conditioning
Security	As required
Instruction	Little or none required - signs and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features	Interlocking power leads and control
Fail Operational Features	Switch open if train in vicinity
Total System Mean Time Before Failure	Over 100 million passenger miles without accident or service breakdown
System Restore Time After Failure	0.5 hrs
Station Mean Time Before Failure	0.5 hrs
Station Restore Time After Failure	Data unavailable
Vehicle Mean Time Before Failure	0.5 hrs
Strategy For Removal of Failed Vehicle	Tow with service vehicle or another standard vehicle to siding, station or maintenance area
Strategy For Passenger Evacuation of Failed Vehicle	Move cars to platform area or service vehicle rescues through emergency end doors.
System Lifetime	30 years for guideway and station
Vehicle Lifetime	10 years

MAINTENANCE:

Inspection Frequency Periodic Maintenance	Information unavailable
Adjustments Required	Power rail alignment and cleaning, autopilot control checks, safty circuit checks, motor brushes, and drive element [b 91]
Other Maintenance	Washdown, lubrication, slide shoe changes, control checks, motor brushes, and drive elements [b 91]

CARGO CAPABILITY:

Passenger Articles	Small packages and hand luggage
Goods Movement	Cargo cars available

PERSONNEL REQUIREMENTS:

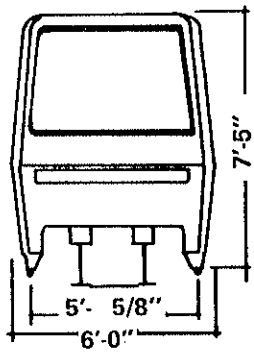
Varies with degree of automation:

Minimum: 3 persons/shift plus 1 supervisor

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 14 ft (4267 mm)
Overall Width . . . . . 6 ft (1829 mm)
Overall Height . . . . . 7.4 ft (2256 mm)
Empty Weight . . . . . 2,400 lbs (1088 kg)
Gross Weight . . . . . 4,500 lbs (2041 kg)
Passenger Space (Design Load) . . . . . 22 in (559 mm) aisle; 22 in (559 mm) knee space; 57 in (1448 mm) seat width
Doorway Width . . . . . (2 per side) 19 in (483 mm)
Doorway Height . . . . . Approx 72 in (1829 mm)
Step Height . . . . . Level



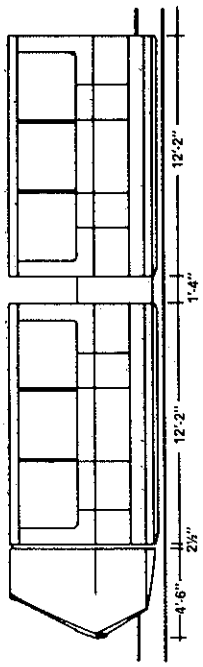
VEHICLE END VIEW

SUSPENSION:

Type . . . . . Pneumatic tires, direct coupled bogey to frame - no intermediate suspension standard
Design Load . . . . . 2,500 lbs (1134 kg)/tire
Lateral Guidance . . . . Horizontally opposed sets of four rubber tired wheels per bogey, positive guidance

PROPULSION & BRAKING:

Type & No. Motors . . . . . Electric motor
Motor Placement . . . . . On-board
Motor Rating . . . . . Up to: 9 HP (6.7 kw)/car; Max: 100 HP (74.6 kwh)/train
Type Drive, Gear Ratio . . . . . Data unavailable
Type Power . . . . . Up to 565 vac, 3ϕ
Power Collection . . . . . Three sets contact shoes ride on power buses
Type Service Brakes . . . . . Dynamic regenerative
Type Emergency Brakes . . . . . Spring applied friction brakes
Emergency Brake Reaction Time . . . . . 0.25 sec



VEHICLE SIDE VIEW

SWITCHING:

Type & Emplacement . . . . . Automatic sliding or turnable switches, on-guideway
Switch Time (lock-to-lock) . . . . . Varies with train length and type of switch
Speed Thru Switch . . . . . Max line speed
Headway Thru Switch . . . . . 60 sec min

GUIDEWAY:

Type . . . . All welded continuous box girder; at, above or below-grade
Materials . . . . . Steel
Running Surface Width . . . . . Data unavailable
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 75 ft (22860 mm)
- Overall Cross Section Width . . . . . 2.5 ft (762 mm)
- Overall Cross Section Height . . . . . 1.83 ft (558 mm)
- Design Load . . . . . Data unavailable

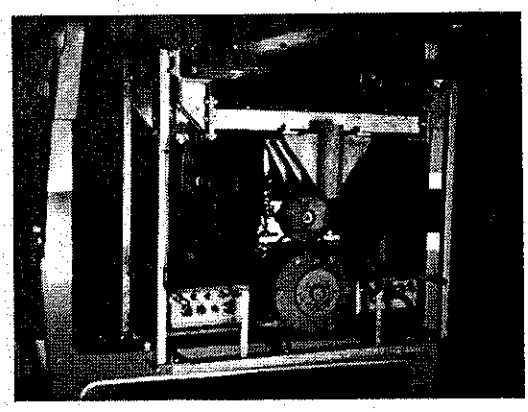
Double Lane Elevated Guideway . . . . . Consists of two separate individual guideways
Guideway Passenger Emergency Egress . . . . . On-guideway, on-foot
Type Elevated Guideway Support Columns . . . . . Normally wide flanged structural section

CONTROL:

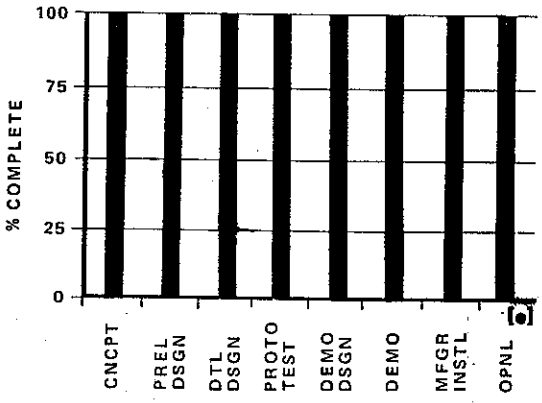
Each train is equipped with an autopilot which controls the speed of the train according to the distance to the train in front. The system is a fail-safe fixed block control. A central computer dispatches the trains regularly at the stations and insures an equal distribution of the trains over the whole line.

STATIONS:

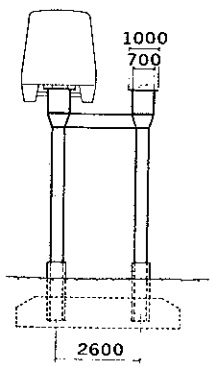
The station equipment permits fully automatic dispatch; i.e., stop of the train at a given place, start after a certain waiting time, which can be adjusted, leaving the station after doors are closed.

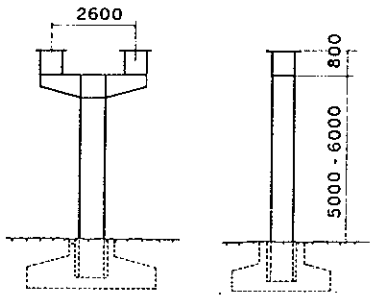


PROPULSION AND SUSPENION SYSTEM



DEVELOPMENT STATUS





Dimensions in mm

SUPPORT COLUMNS

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The Unimobil/Habegger System (Type II) is fully developed and proven with 15 operational installations, whereas the systems Type II-S and Type III are still in development.*

INSTALLATIONS & CONTRACTS: [a]

15 operational systems, some of which are:
- Expo, Montreal, 1967
- Hershey Park in Hershey, Pennsylvania
- Charlotte, North Carolina
- Cincinnati, Ohio
- Richmond, Virginia

COSTS:

Capital . . . . . .Column 15 ft high with foundation - $5,100
Double track - $1.44 million/mile, Station $120,000; 5-car train (125 psgr) - $195,000

Operational . . . . . .Personnel: 15 persons average, plus power at 6 kwh/125 psgr train

Maintenance . . . . . .Capital: maintenance station $360,000
Material cost: $12,000/train/year

INSTALLATION OR RETROFIT CAPABILITY: [a]

Single Lane Guideway Envelope Width	8.99 ft (2740 mm)
Single Lane Guideway Envelope Height	9.19 ft (2800 mm)
Single Lane Guideway Structural Weight	Data unavailable
Double Lane Guideway Structural Weight	Data unavailable
Max Grade	±8% - 10%
Min Vertical Turn Radius	Data unavailable
Min Horizontal Turn Radius	50 ft (15.3 m)
Construction Process	Most guideway path prefabricated
Staging Capability	Expansion possible

LIMITATIONS:

In cold regions the track must be heated for grades greater than 2%.

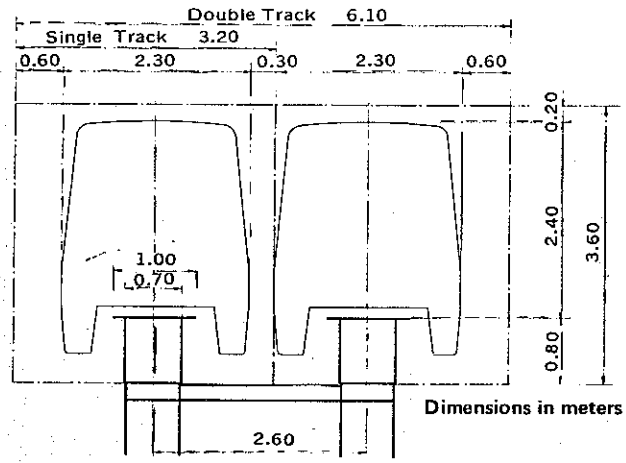
ENVIRONMENTAL IMPACT:

Emissions . . . . . .No direct polluting emissions

Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 1.83 ft (558 mm), H_2 – 8.5 ft (2591 mm)
W_1 – 2.5 ft (762 mm), W_2 – 6.0 ft (1829 mm)
P_1 – 3.84 ft (1170 mm), P_2 – 11.0 ft (3353 mm)

Noise . . . . . .Less than 60 dbA inside the car or 25 ft (7.62 m) from track

***See following entry for Unimobil/Habegger System (Type II-S). Information for Type III was not available at time of printing.**



Dimensions in meters

INSTALLATION ENVELOPS

UNIMOBIL/HABEGGER SYSTEM (TYPE II-S)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: The system is marketed in North America under the name "Unimobil/Habegger System", whereas in Europe the same system carries the name "Minirail".

DEVELOPER: Universal Mobility, Inc.
65 West Louise Avenue
Salt Lake City, Utah 84115, U.S.A.
Tel: (801) 487-5611

Habegger Ltd. Engineering Works
Industriestrasse
Thun, Switzerland
Tel: 033-21837/35421

LICENSEES: None

PATENTS: U.S. patents 3,339,494; 3,391,652; 3,359,922; 3,313,234; and 3,352,254.

DATA REFERENCE CODE: [a 21]

SYSTEM DESCRIPTION:

The Unimobil/Habegger Type II-S system is designed for medium speed transportation of passengers and moderate cargo loads where line speeds of up to 35 mph and station spacings of up to 2 mi are suitable. Max single line passenger capacities are up to 14,000 per hour. The system is designed for operation in loops with guideway switches, which permit interchange of vehicles between loops if necessary. Vehicles can be coupled in trains of up to 5 cars per train each with a max crush capacity per car of 35 passengers. Various seating arrangements are possible without changing the basic vehicle. The system is designed primarily for a line-haul type collection and distribution operation in a dense traffic area.

Vehicles operate on an exclusive guideway constructed of steel. Guideway contains all control, power and guidance appurtenances. Guidance surfaces are an integral part of the structure and also serve as shielding for the power and control rails. Upper surface of the guideway is flat without any protruding surfaces to trap snow or dirt.
Cars are locked onto the guideway in a patented arrangement of guidance and safety wheels.

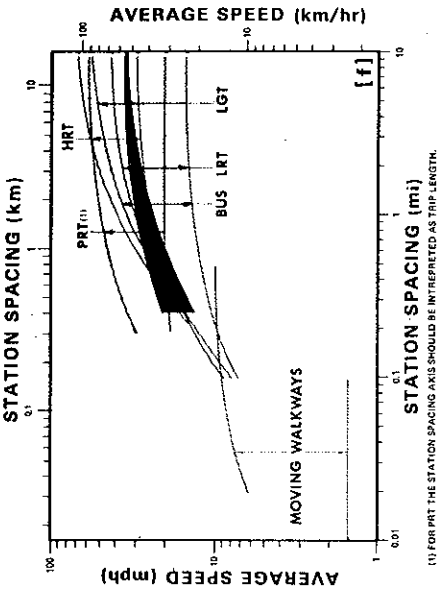
ILLUSTRATIONS UNAVAILABLE

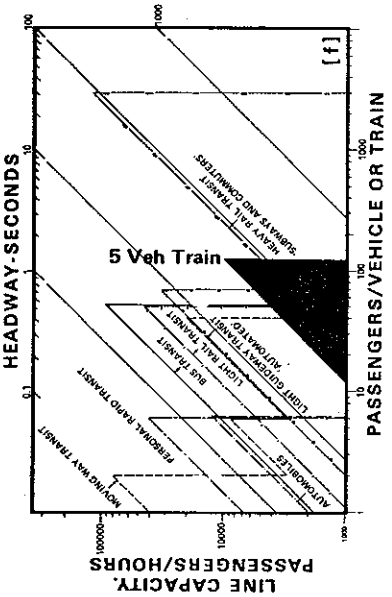
SEE UNIMOBILE/HABEGGER SYSTEM (TYPE II) WHICH ARE SIMILAR

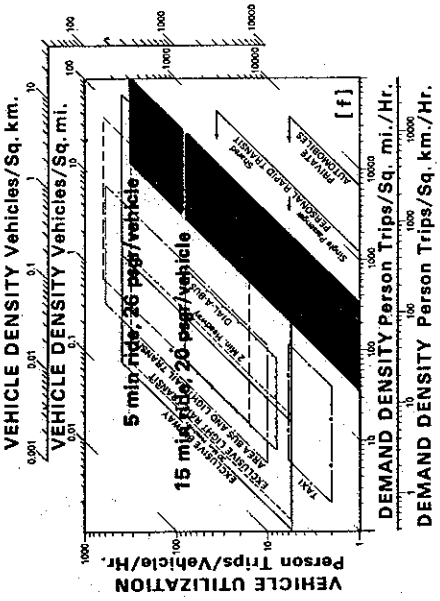
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	14,000 psgr/hr
Max Practical One-Way Capacity	10,000 psgr/hr
Min Theoretical Headway	30 sec
Min Practical Headway	45 sec
Availability	Scheduled or on-demand
Type Service	Primarily line-haul collection & distribution
Type Network	Linear or loops
Type of Vehicle Routing	Fixed; variable possible
Traveling Unit	Single vehicles and/or up to 5-vehicle trains







VEHICLE PERFORMANCE:

Cruise Velocity	35 mph (56 km/h)
Max Velocity	35 mph (56 km/h)
Max Grade	+8%, -10%
Service Acceleration	3.0 ft/s^2 (0.91 m/s^2)
Service Deceleration	3.0 ft/s^2 (0.91 m/s^2)
Max Jerk	6.4 ft/s^3 (1.95 m/s^3)
Emergency Decel	6.4 ft/s^2 (1.95 m/s^2)
Stopping Precision in Station	±3 in (76 mm)
Degradation if Guideway is Wet	No degradation
Degradation for Ice & Snow	No degradation if wheel lines heated
Vehicle Design Capacity*	8 to 14 seated 18 to 6 standing
Vehicle Crush Capacity	8 to 14 seated 28 to 10 standing
Energy Consumption	Data unavailable

STATIONS:

Type	On-line and off-line possible
Type Boarding	Level
Ticket or Fare Collection	As required
Security	Elevator type matching doors; closed circuit TV and central surveillance optional
Boarding Capacity	10,000 psgr/hr/berth
Deboarding Capacity	10,000 psgr/hr/berth
Max Wait Time	90 sec
Vehicle in Station Dwell Time	15 to 60 sec
Average Station Spacing	0.25 to 2 mi (0.4 to 3 km)

INDIVIDUAL SERVICE:

Privacy	Compartment shared by passengers
Transfers	Yes, if multiple loop
Stops	Stops at all/or selected stations
Accommodation	Seated and standing
Comfort	Full air conditioning optional
Security	As required
Instruction	Visible and audible instruction optional

RELIABILITY & SAFETY:

Fail Safe Features	Safety of passengers is secured in case of deflated tires, power loss, interruption of control circuit, loss of voice communication and/or central control.
Fail Operational Features	System can remain in operation in case of loss of up to 30% motor drive power and central control link to vehicle loss.
Total System Mean Time Before Failure	300 hrs
System Restore Time After Failure	0.5 hrs
Station Mean Time Before Failure	2,000 hrs
Station Restore Time After Failure	1 hr
Vehicle Mean Time Before Failure	600 hrs
Strategy For Removal of Failed Vehicle	Tow with service vehicle or another standard vehicle to siding, or station, or maintenance
Strategy For Passenger Evacuation of Failed Vehicle	Move cars to platform area or service vehicles recues through emergency end doors
System Lifetime	20 years
Vehicle Lifetime	1,000,000 mi (1,600,000 km) 10 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed)	
Guideway	0.5 hrs every 1 days/1 mi (1.6 km)
Station	0.5 hrs every 1 days/station
Vehicle	1.0 hrs every 7 days
Periodic Maintenance	
Guideway	5.0 hrs every 180 days/1 mi (1.6 km)
Station	2.0 hrs every 7 days/station
Vehicle	4.0 hrs every 7 days
Adjustments Required	Power rail alignment and cleaning, autopilot control checks, safety circuit checks, pneumatic elements
Other Maintenance	Washdown, lubrication, slide shoe changes, control checks, motor brushes, and drive elements

CARGO CAPABILITY:

Passenger Articles	Carry-on luggage, overcoats, etc.
Goods Movement	Cars can be cargo designed.

*** Variable with arrangement of seats**

PERSONNEL REQUIREMENTS:

Typical system of 30 vehicles, 3 stations and 2 mi (3.2 km) of one-way guideway

No. of Operators/Vehicle	None
No. of Attendants/Station	None, except for safety
No. of Administrative Personnel	2
No. of Central Control Attendants	1.5/shift
No. of Maintenance Personnel	4/shift
Engineering Staff	None

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	17 ft (5182 mm)
Overall Width	7.2 ft (2194 mm)
Overall Height	8.5 ft (2590 mm)
Empty Weight	6,500 lbs (2954 kg)
Gross Weight	3,500 lbs (1591 kg)
Passenger Space (Design Load)	4.0 ft^2 (0.37 m^2) seated 2.4 ft^2 (0.22 m^2) standing
Doorway Width	48 in (1463 mm)
Doorway Height	75 in (1905 mm)
Step Height	Level

SUSPENSION:

Type	Four hard rubber tires/car, secondary pneumatic springs and shock absorbers
Design Load	5,000 lbs (2272 kg)/front suspension 5,000 lbs (2272 kg)/rear suspension
Lateral Guidance	Pairs of wheels at each side of each end bogie; positive guidance from structural guideway

PROPULSION & BRAKING:

Type & No. Motors	Two to four electrical motors, 200 to 380 vdc
Motor Placement	At each end of vehicle
Motor Rating	7.5 to 25 HP, 5.6 to 18.6 kw
Type Drive	Chain or belt
Gear Ratio	Varies
Type Power	440 to 575 vac 3ϕ, 250 max amps
Power Collection	Through slide shoes
Type Service Brakes	Regenerative (SCR)
Type Emergency Brakes	Friction disk or drum
Emergency Brake Reaction Time	0.5 sec

SWITCHING:

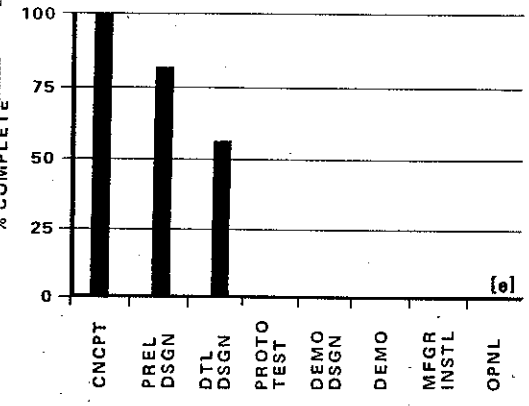
Type & Emplacement	Rotary or sliding switch on-guideway
Switch Time (lock-to-lock)	6 to 14 sec (varies with style)
Speed Thru Switch	15 mph (24 km/h) max
Headway Thru Switch	30 sec min

GUIDEWAY:

Type	At, above or below-grade flat steel plate
Materials	Steel
Running Surface Width	Data unavailable
Single Lane Elevated Guideway:	
Max Elevated Span	Standard 75 ft (22860 mm)
Overall Cross Section Width	3.5 ft (1067 mm)
Overall Cross Section Height	2 ft (609 mm)
Design Load	800 lbs/ft (1192 kg/m)
Double Lane Elevated Guideway	Consists of two separate individual guideways
Guideway Passenger Emergency Egress	On guideway on-foot
Type Elevated Guideway Support Columns	Normally wide flanged structural 21 in to 30 in section

CONTROL:

Headway and line speed is governed by the interaction between a following train and any train immediately preceeding. Voltages produced by the trailing vehicle (control vehicle) are returned from a preceeding vehicle (rear car of the preceeding train). Value of voltages sensed by the trailing train are translated into commands to the train drive depending upon speeds of the trains, interval between them and special conditions imposes upon all trains by limiting factors, such as max programmed line speed, distance from stations, special-line conditions, special commands from a central controller, etc. The system is fully operational and proven in installations both in North America and Europe during the past 11 years. System is suitable for any number of trains and for loop or shuttle systems.



DEVELOPMENT STATUS

No control link is required between vehicles and a central controller. However, central control links can be provided for reporting vehicle and line conditions as well as for communications and special controls, as desired.

Loss of control on any vehicle does not affect the ability of the other vehicles or trains on the line to operate fully automatically. A vehicle without automatic control operational can be operated manually and all other trailing vehicles will be able to function in the normal automatic mode.

Open switches, control-line breaks or shorts, loss of power and other unsafe conditions automatically cause affected vehicles to revert to a safe speed or stop, as conditions require.

STATIONS:

Basic station can consist of a one-sided or two-sided boarding and deboarding platform. Two-sided platforms are suggested for max system capacity. Boarding areas of about 54" width, spaced about 17 ft apart in up to 5 positions, permit fast boarding and deboarding. Matching doors on cars are provided for the platform spacings. Doors open only when vehicle doors are opposite and accessible.

Vehicle floors match the elevation of the boarding platforms. Platform widths suggested are not less than 6 ft on the deboarding side and not less than 10 ft on the boarding side. Max platform length for max train size is 80 ft.

Dispatching can be arranged for a manual control by station attendant; fixed dwell and automatic dispatch or variable dwell and centrally controlled dispatching. Dispatching can also be passenger initiated from within the vehicles where such is required.

TV, fire surveillance, station automatic ticketing and similar control features can be incorporated in station designs. Stations are normally on-line and all vehicles stop at each station. However, selective stopping is easily accomplished and off-line stations can be arranged with existing switching equipment.

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The parent system, Minirail, has been proven in many installations. The type II-S is a logical outgrowth of the type II Minirail (Unimobil/Habegger), which has previously been operated to transport over 250 million passengers. The type II-S system is undergoing extensive development which should lead to a fully operational system during late 1975 and early 1976. Control systems, guideway components, maintenance operations and portions of the vehicles have already been developed.

INSTALLATIONS & CONTRACTS:

None

COSTS:

Information unavailable (Developer will quote.)

INSTALLTION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . . . 3.5 ft (1067 mm)
Single Lane Guideway Envelope Height . . . . . 2 ft (610 mm)
Single Lane Guideway Structural Weight (for span 60 ft) . . . . . 170 lbs/ft (255 kg/m)
Double Lane Guideway Structural Weight (for span 60 ft) . . . . . 340 lbs/ft (510 kg/m)
Max Grade 8%
Min Vertical Turn Radius . . . . . 300 ft (91 m) at 35 mph (50 km/h)
Min Horizontal Turn Radius . . . . . 40 ft (12 m) at 6 mph (10 km/h)
Construction Process . . . . . Prefabricated guideway, light columns
Staging Capability . . . . . Guideway easily removed or relocated due to light weight; minor downtown to add to system, vehicles easily added or removed.

LIMITATIONS:

At-grade installations require trough about 24 inches deep to accommodate guideway. Snow and ice traction and track heating along restricted wheel path line recommended in such conditions.

ENVIRONMENTAL IMPACT:

Emissions . . . . . None except those by SCR power conversion
Visual, Single Lane Elevated Guideway . . . . .
H_1 – 1.8 ft (549 mm), H_2 – 9.4 ft (2865 mm)
W_1 – 3.5 ft (1067 mm), W_2 – 7.2 ft (2195 mm)
P_1 – 6.3 ft (1921 mm), P_2 – 11.6 ft (3538 mm)
Noise . . . . . Data unavailable

URBA 30

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Compagnie d'Energétique Linéaire m.b.
5 rue Monge, 92-Vanves-France
Tel: 644 33 22

AFFILIATE: MBM Powercells Ltd.
for U.K. Park Farm House
Ashtead, Surrey
Ashtead 72197
England

LICENSEES: SETURBA-France
Société Canadienne de L'Urba-Canada

PATENTS: French Patents Nos. 1.474.851; 91.423; 93.421; 2.053.827; 2.090.018; 2.105.069; 2.219.119; 2.151.633

DATA REFERENCE CODE: [a: except as noted]

SYSTEM DESCRIPTION:

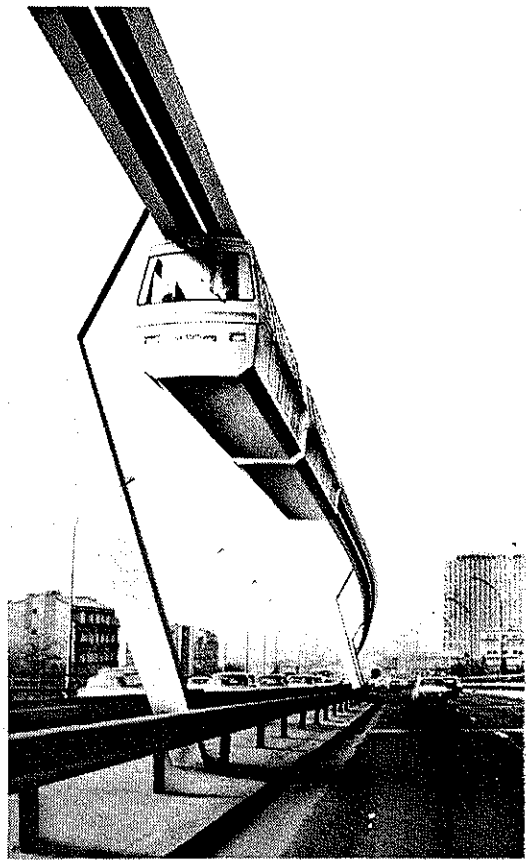
Urba is a tracked public transport system in which the vehicles are suspended below an overhead monorail by means of "air bogies" and powered by linear electric motors. The principle is known as suction-suspension or the Dynavac principle.

The URBA 30 comprises 30-seat vehicles which may be coupled together in trains of up to 8 vehicles each. The system control may either be manual or automatic. With a headway of 80 to 90 seconds, proven automation techniques may be used. The system provides scheduled collection and distribution service along a line, in a loop, or in a limited area.

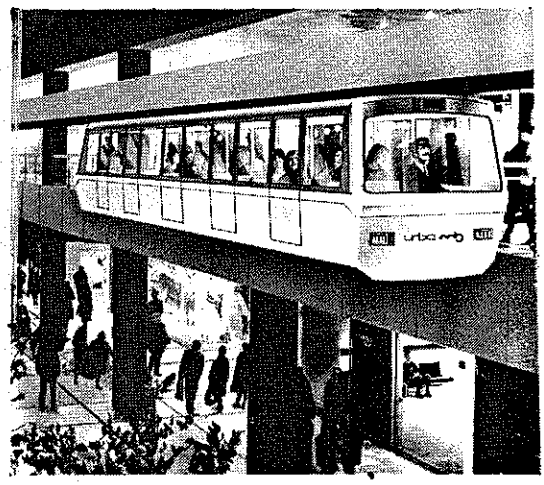
A second generation of URBA, now being studied includes an URBA - PRT and an URBA - DUO-MODE using the same suspension and propulsion methods.

PUBLISHER'S NOTE:

The most developed URBA system is the URBA 30 which is designed to fill the gap between subway and bus transit for capacity. These data sheets are based on that system. An URBA 100 has also been proposed.



PHOTOMONTAGE OF TYPICAL GUIDEWAY INSTALLATION

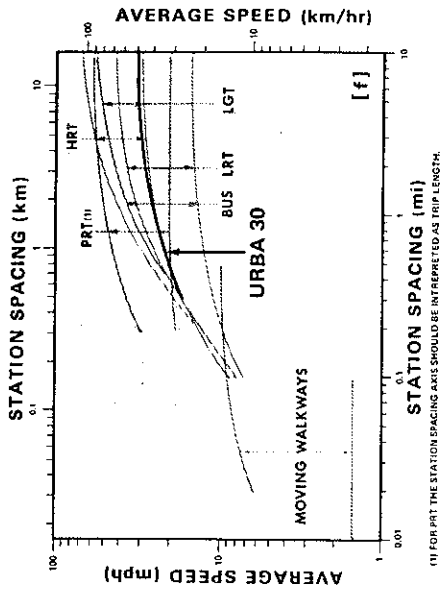


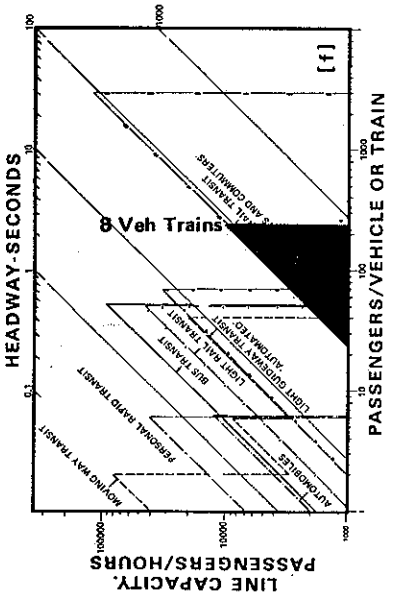
PHOTOMONTAGE OF TYPICAL STATION INSTALLATION

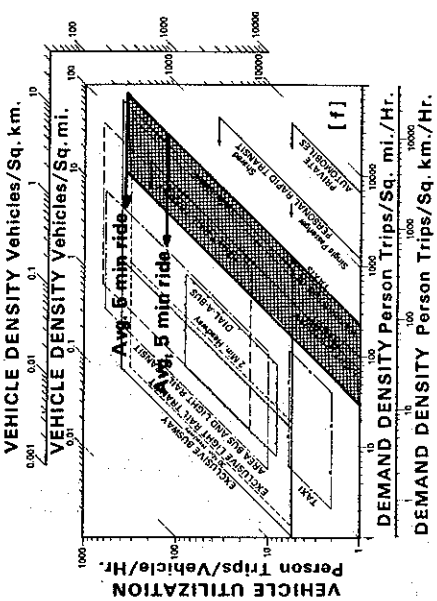
OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity	14,400 psgr/hr in 8 vehicle trains
Max Practical One-Way Capacity	10,000 psgr/hr in 8 vehicle trains
Min Theoretical Headway	60 sec
Min Practical Headway	85 sec
Availability	Scheduled
Type Service	Limited area collection and distribution
Type Network	Loops, line-haul, or limited area
Type of Vehicle Routing	Fixed
Traveling Unit	One vehicle and trains with up to 8 vehicles







VEHICLE PERFORMANCE:

Cruise Velocity	31 mph (50 km/h)
Max Velocity	44 mph (70 km/h)
Max Grade	10%
Service Acceleration	4.1 ft/s^2 (1.25 m/s^2)
Service Deceleration	4.1 ft/s^2 (1.25 m/s^2)
Max Jerk	3.28 ft/s^3 (1.00 m/s^3)
Emergency Decel	8.2 ft/s^2 (2.5 m/s^2)
Stopping Precision in Station	5 in (127 mm)
Degradation if Guideway is Wet	None
Degradation for Ice & Snow	None
Vehicle Design Capacity	30 seated 0 standing
Vehicle Crush Capacity	30 seated 0 standing
Energy Consumption, Accelerating and Decelerating Only	
Empty Vehicle	6.4 kwh/veh-mi (4.0 kwh/veh-km)
At Design Capacity	8.1 kwh/veh-mi (5.0 kwh/veh-km)
Energy Consumption, Cruise Only	
Empty Vehicle	4.35 kwh/veh-mi (2.7 kwh/veh-km)
At Design Capacity	5.23 kwh/veh-mi (3.25 kwh/veh-km)

STATIONS:

Type	On-line and off-line, elevated, at-grade or below-grade
Type Boarding	Level
Ticket or Fare Collection	Not specified
Security, Boarding Capacity, Deboarding Capacity	As required — not specific to URBA 30
Max Wait Time	20 to 30 sec
Vehicle in Station Dwell Time	30 sec
Average Station Spacing	0.3 - 0.6 mi (0.5 - 1 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles
Transfers	As required
Stops	Stops for other passengers
Accommodation	Seated only
Comfort	Heated and air conditioned vehicles
Security	Information unavailable
Instruction	Information unavailable

RELIABILITY & SAFETY:

Fail Safe Features . . . . . In case of power failure or if power is turned off, vehicles land on tracks and come to a stop without any mechanical device.

Fail Operational Features . . . . . Vehicle can remain in slow operation even if one motor or if one air cushion is not operated. Distressed vehicles can be towed.

Total System Mean Time Before Failure, System Restore Time After Failure, Station Mean Time Before Failure, Station Restore Time After Failure, Vehicle Mean Time Before Failure	Data unavailable
Strategy For Removal of Failed Vehicle	Tow vehicles on a side track
Strategy For Passenger Evacuation of Failed Vehicle	Air inflatable emergency egress chute
System Lifetime	Data unavailable
Vehicle Lifetime	Data unavailable

MAINTENANCE:

Approx 10% spare vehicles required, other information unavailable

CARGO CAPABILITY:

Passenger Articles	Small packages and hand luggage
Goods Movement	Not provided

PERSONNEL REQUIREMENTS:

Typical System of 48 vehicles, 13 stations and automatic operation

Total personnel	26

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 29.5 ft (9000 mm)
Overall Width . . . . . 6.56 ft (2000 mm)
Overall Height . . . . . 6.56 ft (2000 mm)
Empty Weight . . . . . 8,000 lbs (3636 kg)
Gross Weight . . . . . 12,000 lbs (5455 kg)
Passenger Space (Design Load) . . . . . 5.4 ft^2 (0.5 m^2) seated
Doorway Width . . . . . 23.23 in (590 mm)
Doorway Height . . . . . 64.96 in (1650 mm)
Step Height . . . . . Level

SUSPENSION:

Type . . . . . 6 air suction bogies per vehicle
Design Load . . . . . 2,992 lbs (1360 kg)/bogey
Lateral Guidance . . . . . Air suction to side walls of guideway

PROPULSION & BRAKING:

Type & No. Motors . . . . . 6 linear induction motors per vehicle
Motor Placement . . . . . Under floor
Motor Rating . . . . . 26.8 HP, 20 kw
Type Drive . . . . . Linear motor
Type Power . . . . . 500 vac 3ϕ
Power Collection . . . . . Through catenaries
Type Service Brakes . . . . . Dynamic through linear motors
Type Emergency Brakes . . . . . Opening of air chamber and landing on shoe brakes
Emergency Brake Reaction Time (i.e., time period from first sensing a failure to reaching full rated braking) . . . . . 0.5 sec

SWITCHING:

Type & Emplacement . . . Mechanical movement of guideway sections, on-guideway
Switch Time (lock-to-lock) . . . . . 5 sec
Speed Thru Switch . . . . . 31 mph (50 km/h) max
Headway Thru Switch . . . . . 60 sec

GUIDEWAY:

Type . . . . . Overhead inverted u-shaped beam
Materials . . . . . Steel or concrete
Single Lane Elevated Guideway:
- Max Elevated Span . . . . . 328 ft (100000 mm)
- Overall Cross Section Width . . . . . 5.12 ft (1560 mm) at top, 5.68 ft (1,730 mm) at bottom
- Overall Cross Section Height . . . . . 5.26 ft (1603 mm)
- Design Load . . . . . Data unavailable

Double Lane Elevated Guideway:
- Max Elevated Span . . . . . 328 ft (100000 mm)
- Overall Cross Section Width, Overall Cross Section Height, Design Load . . . . . Data unavailable

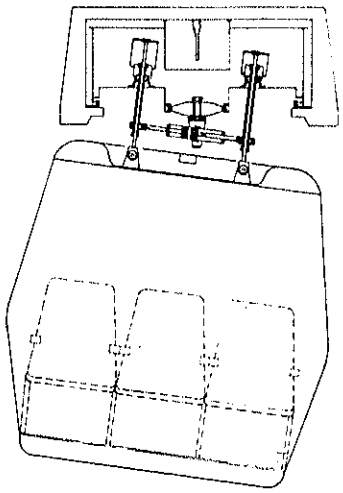
Guideway Passenger Emergency Egress . . . . . None
Type Elevated Guideway Support Columns . . . . . As required

CONTROL:

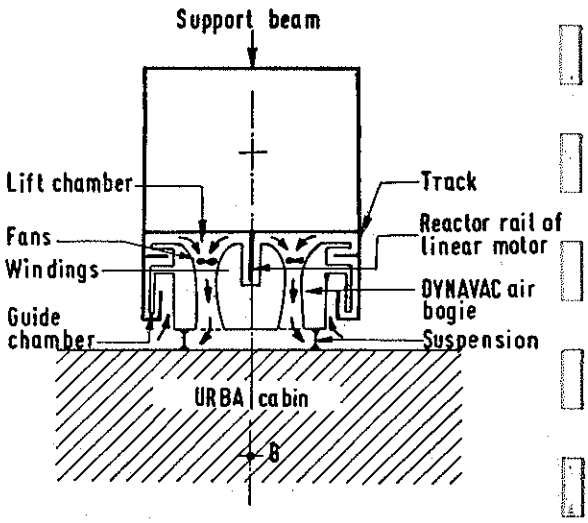
Any control may be used, mainly existing subway control system envisioned. Vehicle is equipped with driver seat and may therefore be operated manually. Fixed block headway and anti-collision system is assumed [e].

STATIONS:

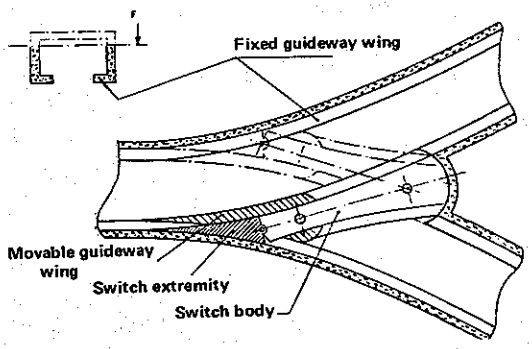
Generally not specified, platform dimension requirements of 262 ft (80 m) length for an 8-vehicle train and 7.2 ft (2.2 m) wide.



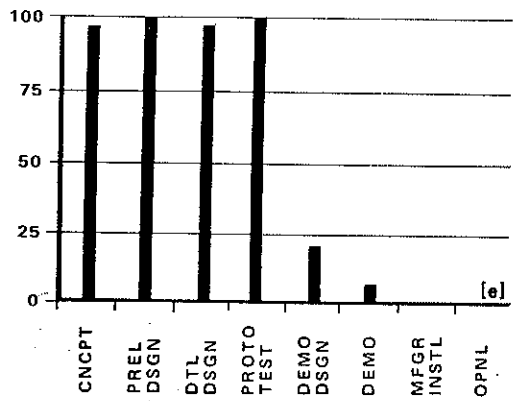
VEHICLE SUSPENSION



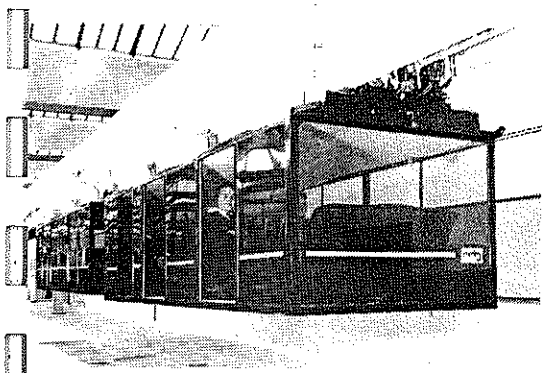
DYNAVAC SUSPENSION PRINCIPLE



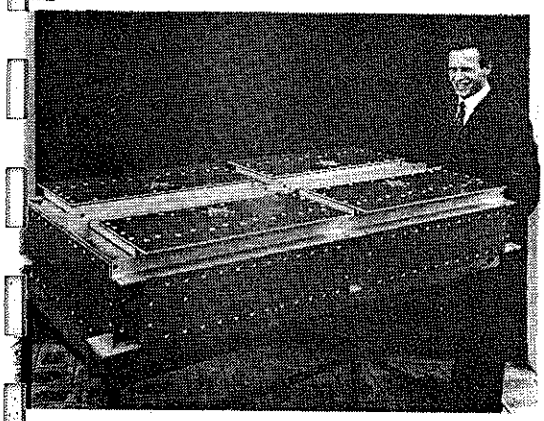
GUIDEWAY SWITCH



DEVELOPMENT STATUS



PROTOTYPE TEST VEHICLES AND GUIDEWAY



SUSPENSION BOGEY OF PROTOTYPE

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The suspension principle was developed in 1966 by Mr. M. Barthalon and tested on several models with different sizes. An 80 meter track with a train of 10-seat vehicles has carried 25,000 visitors since March, 1968. A computer simulation of the dynamic behavior of the vehicles and the bogies was performed. At present the organization Société Civile pour L'Etude et le Dévelopment de l'Urba et de ses Dérives (SETURBA) has been set up for the industrial development program.

INSTALLATIONS & CONTRACTS:

None

COSTS:

Capital . . Approx $4.18 million/mi (13 million F.F./km) all included $520,000 (2.6 million F.F.) for guideway/support foundations, double-guideway

Operational / Maintenance . . . . . 1.25 cents/seat-mi (3.9 French cents/seats-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width . . . Approx 10.5 ft (3200 mm)
Single Lane Guideway Envelope Height . . . Approx 10.5 ft (3200 mm)
Single Lane Guideway Structural Weight . . . . . Data unavailable
Double Lane Guideway Structural Weight . . . . . Data unavailable
Max Grade 10%
Min Vertical Turn Radius . . . . . 1640 ft (500 m) at 40 mph (64 km/h)
Min Horizontal Turn Radius . . . . . 131 ft (40 m)
Construction Process . . . . . Prefabricated guideway sections
Staging Capability . . . . . Sections can be operated while others under construction.

LIMITATIONS: [e]

Switching system appears to be complicated by the DYNAVAC suspension system. If conventional railroad control is employed then minimum headway will be fixed. If guideway is suspended by guy wires, then installation will require large verticle clearance.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions
Visual, Single Lane Elevated Guideway . . . . . .
H_1 – 2.56 ft (780 mm), H_2 – 9.34 ft (2850 mm)
W_1 – 5.68 ft (1730 mm), W_2 – 6.5 ft (1980 mm)
P_1 – 5.4 ft (1650 mm), P_2 – 10 ft (3050 mm)
Noise . . . . . 70 dbA at 23 ft (7 m) from guideway

ARTIST RENDERING OF INSTALLATION PROPOSED FOR CITY OF ROVEN

VAL

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPERS: Engins Matra
Avenue Louis Breguet
78.140 Vélizy, France
Tel: 946.96.00
Telex: ENMATRA 69.077 F

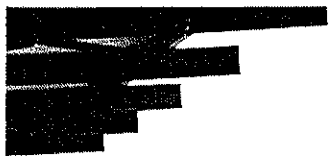
C.E.M.
27, rue du Rocher
75.382 Paris 2 éme
France

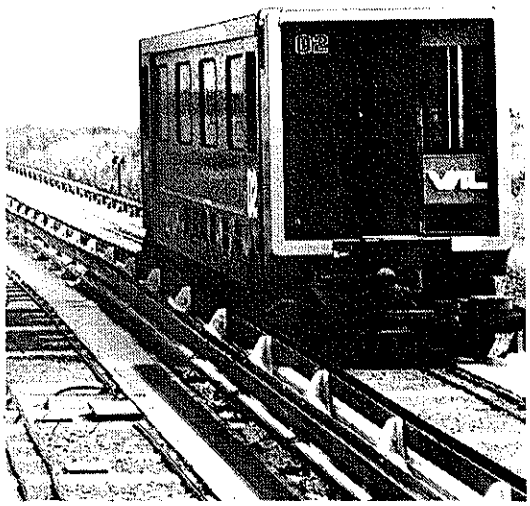
C.I.M.T. Lorraine
42, av. Raymond-Poincare
75.016 Paris 16 eme
France

LICENSEES: None

PATENTS: Patents granted in France, USA, UK, RFA, Italy, Switzerland, Belguim, Japan, Argentina, Spain, and Canada

DATA REFERENCE CODE: [a 41: except as noted]





PROTOTYPE VEHICLE

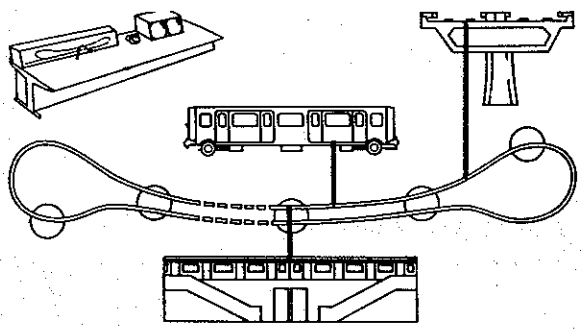
SYSTEM DESCRIPTION:

VAL is a Light Guideway Transit system (Métro a Véhicules Automatiques Légers). Moreover, the name VAL is also acronym for Villeneuve-d'Ascq-Lille, the first implementation project of the system.

Connected vehicle pairs ride on rubber tires over an exclusive guideway carrying passengers along lines or in loops in a collection/distribution service. The system is completely automated and headways of 60 seconds are envisioned. The vehicles operate on an autonomous way working out their speed program by using passive blades laid on the track but under constant surveillance from a central control station.

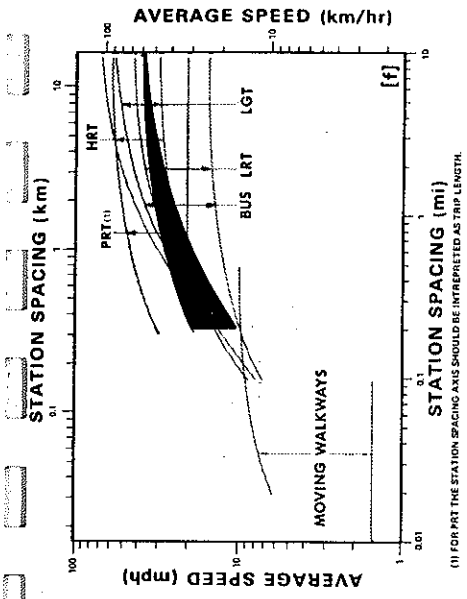
The system is planned to be the main transportation system of the City of Lille, the first line connecting the new town created at Villeneuve D'Ascq with the city of Lille and serving a large part of the city.

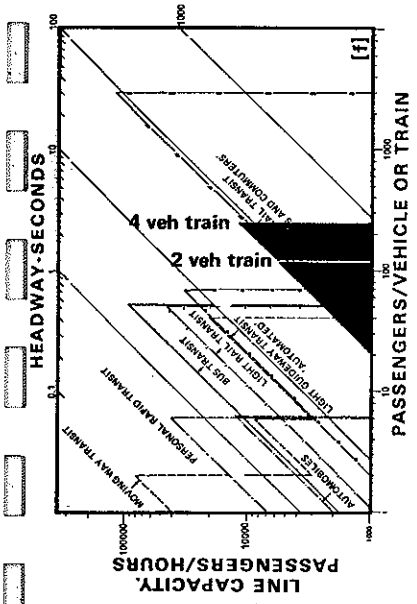
PROTOTYPE VEHICLE AND STATION

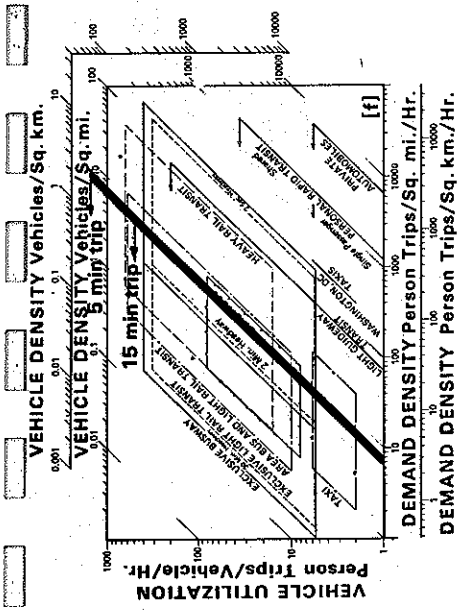


SYSTEM ELEMENTS

VEHICLE INTERIOR







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . . 15,000 psgr/hr
Max Practical One-Way Capacity . . . . . 12,000 psgr/hr [e]
Min Theoretical Headway . . . . . 60 sec
Min Practical Headway . . . . . 75 sec [e]
Availability . . . . . Scheduled or on-demand
Type Service . . . . . Linear or limited area collection & distribution
Type Network . . . . . Linear or loops
Type of Vehicle Routing . . . . . Fixed
Traveling Unit . . . . . 2 or 4 vehicle trains

VEHICLE PERFORMANCE: (2 veh train)

Cruise Velocity . . . . . 37 mph (59.6 km/h)
Max Velocity . . . . . 50 mph (80.5 km/h)
Max Grade 10%
Service Acceleration . . . . . 4.26 ft/s^2 (1.3 m/s^2)
Service Deceleration . . . . . 4.26 ft/s^2 (1.3 m/s^2)
Max Jerk . . . . . 2.0 ft/s^3 (0.6 m/s^3)
Emergency Decel . . . . . 6.57 ft/s^2 (2.0 m/s^2)
Stopping Precision in Station . . . . . ±1.00 in (±25.4 mm)
Degradation if Guideway is Wet . . . . . Data unavailable
Degradation for Ice & Snow . . . . . Data unavailable
Vehicle Design Capacity . . . . . (12 folding seats) 62 seated 63 standing
or 50 seated (no folding seats) 88 standing
Vehicle Crush Capacity . . . . . 50 seated 140 standing
Energy Consumption . . . . . Under study

STATIONS:

Type . . . . . On-line
Type Boarding . . . . . Level
Ticket or Fare Collection . . . . . Automatic
Security . . . . . Closed circuit TV, voice communication
Boarding Capacity . . . . . Up to 15,000 psgr/hr [e]
Deboarding Capacity . . . . . Up to 15,000 psgr/hr [e]
Max Wait Time . . . . . 1 min
Vehicle in Station Dwell Time . . . . . 30 sec [f]
Average Station Spacing . . . . . 0.75 mi (1.2 km)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicles.
Transfers . . . . . Yes, onto other lines
Stops . . . . . Yes, for other passengers
Accommodation . . . . . Seated and standing
Comfort . . . . . Molded seats, ventilation, climatisation possible
Security . . . . . Data unavailable
Instruction . . . . . Signs and voice communication with central monitoring station

RELIABILITY & SAFETY:

Fail Safe Features . . . . . Overspeed and anti-collision service, battery for vital controls
Fail Operational Features . . . . . Overspeed and anti-collision service
Total System Mean Time Before Failure
System Restore Time After Failure
Station Mean Time Before Failure
Station Restore Time After Failure
Vehicle Mean Time Before Failure
. . . . . Now under review
Strategy For Removal of Failed Vehicle . . . . . Failed train may be pushed by next one.
Strategy For Passenger Evacuation of Failed Vehicle . . . . . Data unavailable
System Lifetime . . . . . 30 years
Vehicle Lifetime . . . . . Data unavailable

MAINTENANCE:

Garage and maintenance shop facilities

CARGO CAPABILITY:

Passenger Articles . . . . . Small articles and luggage [e]
Goods Movement . . . . . Not provided [e]

PERSONNEL REQUIREMENTS:

Attendants at central control and maintenance personnel

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . 83.6 ft (25481 mm)
Overall Width . . . . . 6.25 ft (1905 mm)
Overall Height . . . . . 10.0 ft (3048 mm)
Empty Weight . . . . . 50,600 lbs (22947 kg)
Gross Weight . . . . . 70,400 lbs (31926 kg)
Passenger Space (Design Load) . . . . . Data unavailable
Doorway Width . . . . . 51.24 in (1302 mm)
Doorway Height . . . . . 75.96 in (1929 mm)

SUSPENSION:

Type . . . . . Supported on rubber tires and pneumatic suspension with constant height control
Design Load . . . . . Data unavailable
Lateral Guidance . . . . . 4 horizontal pneumatic wheels at each hub level
Obstacle Clearance . . . . . Frontal protecting device actuates emergency brakes

PROPULSION & BRAKING:

Type & No. Motors . . . . . 2 electric motors, dc
Motor Placement . . . . . On-board vehicle
Motor Rating . . . . . 180 kw
Type Drive . . . . . Data unavailable
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 800 vdc
Power Collection . . . . . Side rail
Type Service Brakes . . . . . Dynamic regenerative and pneumatic
Type Emergency Brakes . . . . . Electrically controlled pneumatic
Emergency Brake Reaction Time . . . . . 0.2 sec

SWITCHING:

Type & Emplacement . . . . . Mechanical movement of guiderail, guideway located
Switch Time (lock-to-lock) . . . . . 10 sec
Speed Thru Switch . . . . . Not limited by switch
Headway Thru Switch . . . . . Must be greater than 15 sec [f]

GUIDEWAY:

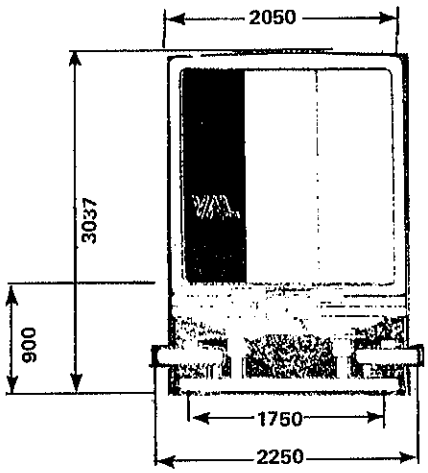
Type . . . . . Dual running surface with side guiderails
Materials . . . . . Prestressed concrete
Running Surface Width . . . . . 7.0 ft (2133.6 mm)
Single Lane Elevated Guideway:
Max Elevated Span
Overall Cross Section Width
Overall Cross Section Height
Design Load
Double Lane Elevated Guideway:
Max Elevated Span
Overall Cross Section Width
Overall Cross Section Height
Design Load
. . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . . Data unavailable
Type Elevated Guideway Support Columns . . . . . Data unavailable

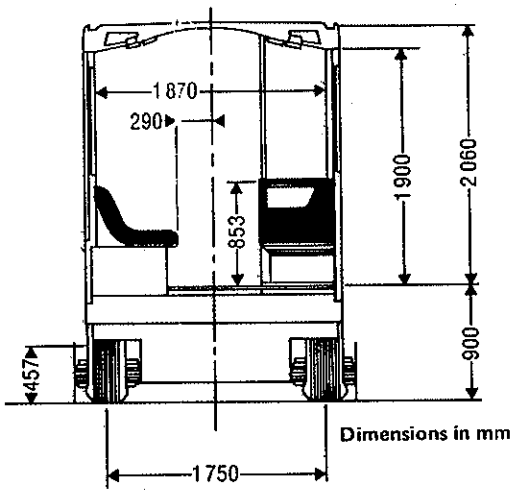
CONTROL:

On-board control (on one vehicle per train) for speed control, stopping at station, door opening, headway control and security devices (overspeed and anti-collision); central control station for monitoring: automatic train control, the on-board safety devices (in the event of failures), stations, sub-stations; central computer with 6K-word memory

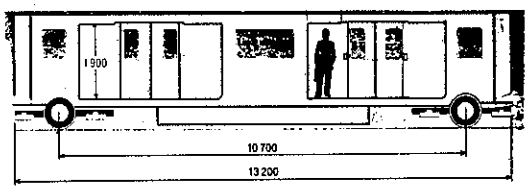
STATIONS:

Stations may be completely unattended. For 2 platforms a length of 98 ft (30 m) and width of 39 ft (12 m) are required. The stations are completely enclosed for weather protection and safety.

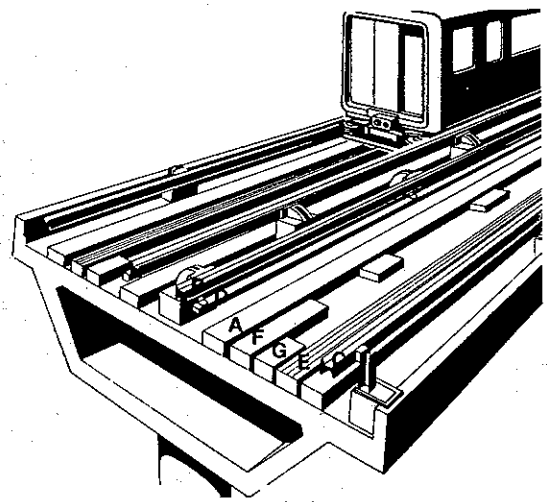




VEHICLE END VIEW

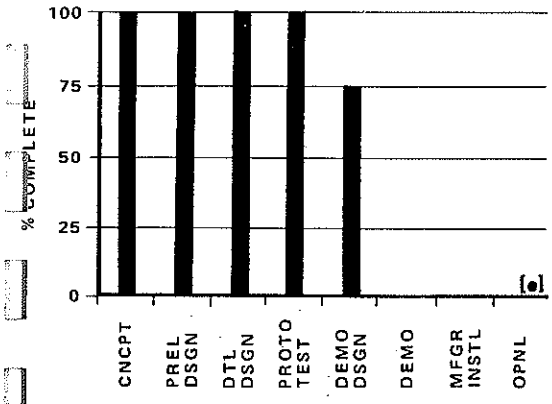


SINGLE VEHICLE SIDE VIEW

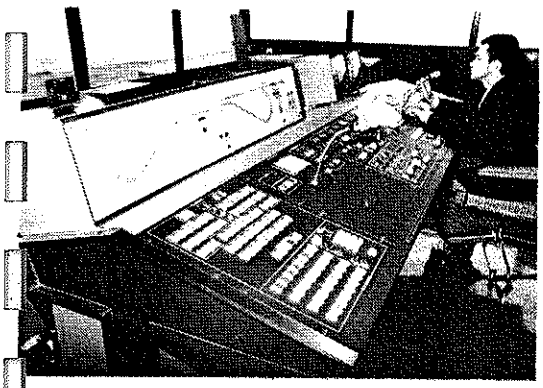


A — Running track (with heating)
B — Guiderail & negative potential elec. rail
C — Guide rail & grounding rail
D — Positive electric rail
E — Transmission lines
F — Contact studs (speed control)
G — Contact studs (anti-collision)

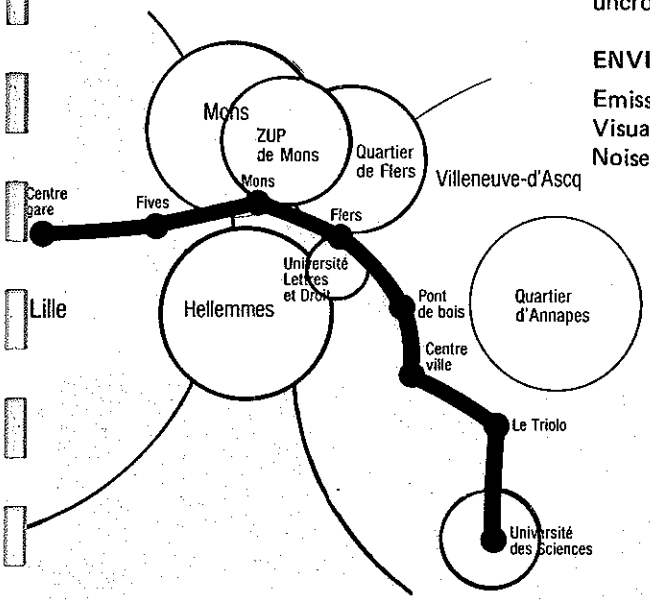
GUIDEWAY ELEMENTS



STATUS OF DEVELOPMENT



CONTROL CENTER AT TEST TRACK



LINE-HAUL NETWORK CONNECTING LILLE WITH VILLENEUVE-D'ASCQ

DEVELOPMENT HISTORY, PLANS & PROGRESS:

In 1971 the group VAL was retained for the project of Lille by EPALE (Etablissement Public d'Aménagement de la Ville Nouvelle de Lille Est, Cité Adminsitrative - 19 éme. étage, 59.048 Lille Cedex).

A test track was installed during the summer of 1973 and the beginning of commercial service was planned for late 1974 — 5 mi (8 km) of two-way guideway and 8 stations.

INSTALLATIONS & CONTRACTS:

System under construction to connect the city of Lille with the new town of Villeneuve-d'Ascq. serving a number of stops in between — commercial service was to begin in late 1974 over 5 mi (8 km) of double guideway between 8 stations. (Total system estimated cost of $8 to 10 million not including civil works)

COSTS: [b]

Capital . . . . . $2.4-3 million/mi (12-15 million FFr/km) for total system (double guideway) not including civil engineering

Operational / Maintenance . . . . . Data unavailable

INSTALLATIONS OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width
Single Lane Guideway Envelope Height
Single Lane Guideway Structural Weight
Double Lane Guideway Structural Weight . . . . . Data unavailable

Max Grade 10%
Min Vertical Turn Radius . . . . . Data unavailable
Min Horizontal Turn Radius . . . . . 131 ft (40 m)
Construction Process . . . . . Prestressed guideway construction, preferably prefabricated
Staging Capability . . . . . Loops or sections of line could be operated while others under construction [e]

LIMITATIONS: [e]

Permission of standees limits accel/decel to approx 4.4 ft/s^2 (1.34 m/s^2).

Fixed Block headway control and anti-collision fixes min headway to design value.

Overall size of vehicle and guideway may limit installations to uncrowded sites.

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]
Visual, Single Lane Elevated Guideway . . . . . Data unavailable
Noise . . . . . 70 dbA inside vehicle
70 dbA at 197 ft (60 m)

VONA SYSTEM (Vehicles of New Age)

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: None

DEVELOPER: Mitsui & Co., Ltd.
2-9, Nishi Shimbashi
Itchome, Minato-ku
Tokyo, Japan
Tel: Tokyo (505) 3508
Telex: J22253

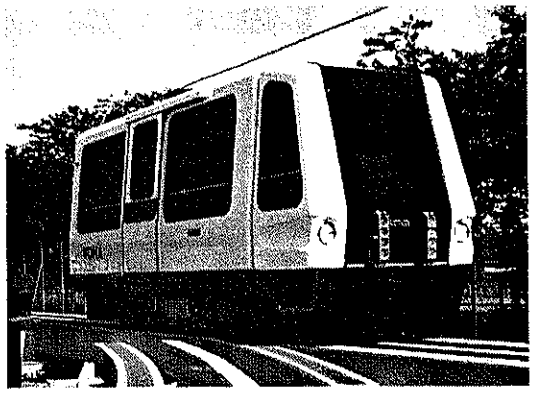
Nippon Sharyo Seizo Kaisha, Ltd.
New Transportation Division
1-1, Sanbonmatsu-cho, Atsuta-ku
Nagoya, Japan
Tel: Nagoya (882) 3311

LICENSEES: Mitsui & Co. (U.S.A.), Inc.
Pan American Bldg.
200 Park Avenue
New York, New York 10017, U.S.A.
Tel: (212) 973-4600

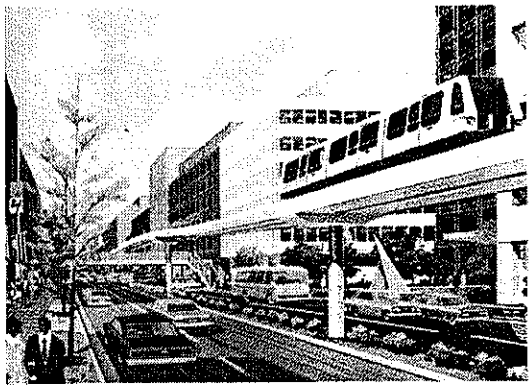
Mitsui & Co. (Canada) Ltd.
3333 Place Ville Marie
Montreal 113, P.Q., Canada
Tel: (514) 866-4327

PATENTS: Under application in Japan

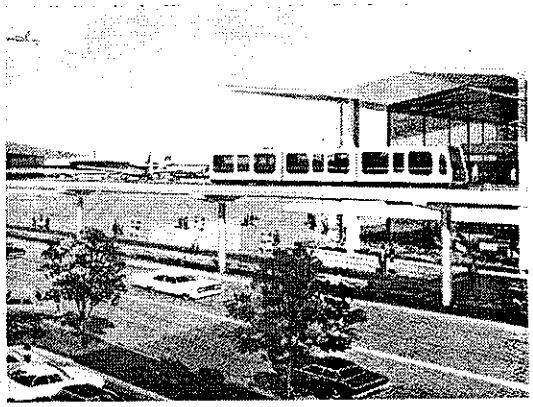
DATA REFERENCE CODE: [a: except as noted]



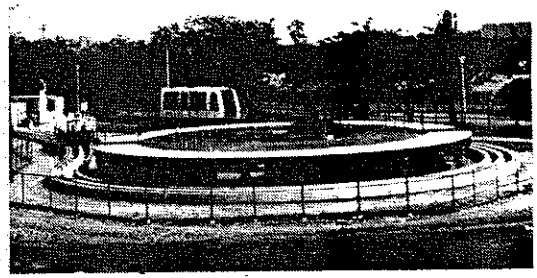
VEHICLE



ARTIST VIEW OF
STREET INSTALLATION



ARTIST VIEW OF
AIRPORT INSTALLATION



ROTATING STATION PLATFORM

SYSTEM DESCRIPTION:

The Vona System is a completely automated Light Guideway Transit system of electrically propelled rubber tired vehicles operated in trains of 3-12 vehicles over an exclusive guideway. The number of vehicles per train, headway, dwell time, and speed are adjusted automatically from a central computer. Service is both scheduled and on-demand.

The developers propose that the VONA System is applicable for passenger service in activity centers, local service in a new town, and in airports. Cargo service is proposed for refuse collection, baggage in airports, and cargo in harbors.

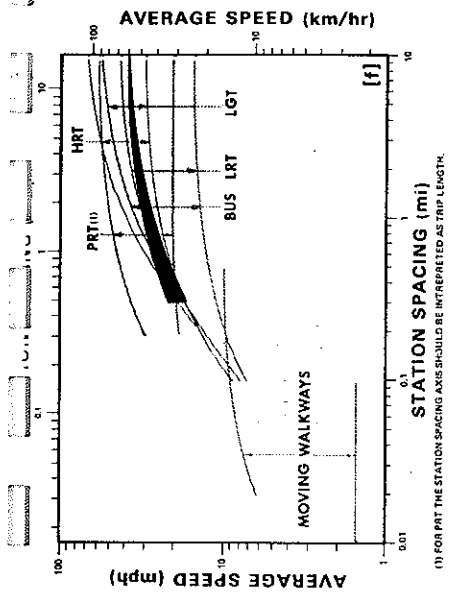
OPERATIONAL CHARACTERISTICS

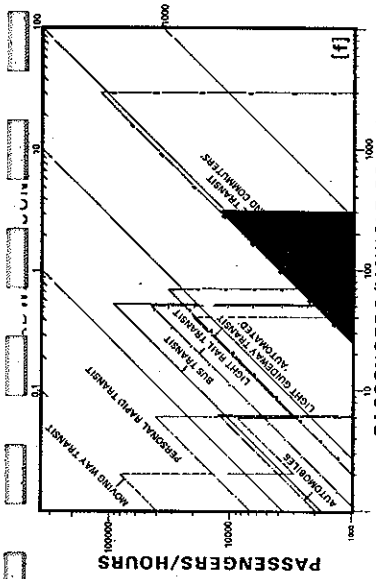
SYSTEM PERFORMANCE:

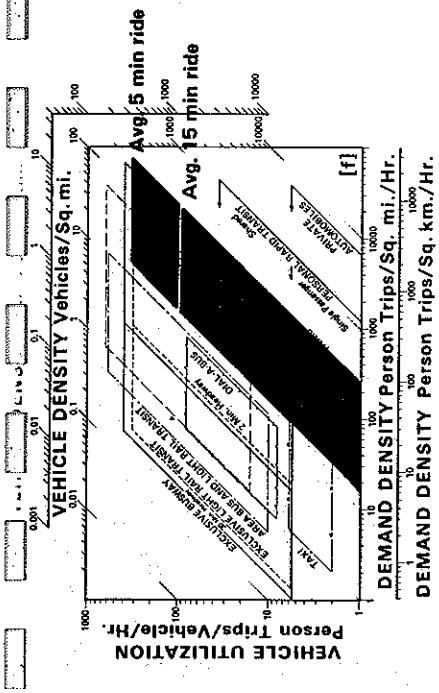
Max Theoretical One-Way Capacity	18,000 psgr/hr
Max Practical One-Way Capacity	12,000 psgr/hr
Min Theoretical Headway	60 sec
Min Practical Headway	90 sec
Availability	Scheduled and on-demand
Type Service	Limited area collection and distribution or line-haul
Type Network	Linear or loops
Type of Vehicle Routing	Fixed
Traveling Unit	Single vehicles or 3 to 12 vehicle trains

VEHICLE PERFORMANCE:

Cruise Velocity	37 mph (60 km/h)
Max Velocity	45 mph (72 km/h)
Max Grade	7%







Service Acceleration	2.25 ft/s^2 (0.69 m/s^2)
Service Deceleration	2.25 ft/s^2 (0.69 m/s^2)
Max Jerk	3.2 ft/s^3 (0.98 m/s^3)
Emergency Decel	4.1 ft/s^2 (1.25 m/s^2)
Stopping Precision in Station	±11.8 in (±300 mm)
Degradation for Ice & Snow	Same as clear, if guideway is enclosed
Vehicle Design Capacity	11 seated 14 standing
Vehicle Crush Capacity	11 seated 24 standing
Energy Consumption, Accelerating and Decelerating Only	
Empty Vehicle	0.51 kwh/veh-mi (0.87 kwh/veh-km)
At Design Capacity	0.62 kwh/veh-mi (0.99 kwh/veh-km)
Energy Consumption, Cruise Only	
Empty Vehicle	0.35 kwh/veh-mi (0.57 kwh/veh-km)
At Design Capacity	0.47 kwh/veh-mi (0.76 kwh/veh-km)

STATIONS:

Type	On-line
Type Boarding	Level
Ticket or Fare Collection	Automatic
Security	Closed circuit TV
Boarding Capacity	15,000 psgr/hr/platform
Deboarding Capacity	15,000 psgr/hr/platform
Max Wait Time	10 min
Vehicle in Station Dwell Time	20 to 30 sec
Average Station Spacing	0.5 mi (0.8 km)

INDIVIDUAL SERVICE:

Privacy	Passengers share vehicles.
Transfers	As required
Stops	Vehicles stop at each station.
Accommodation	Seated and standing
Comfort	Air conditioning
Security	Radio, fire extinguisher, emergency devices
Instruction	Instruction panel and audio announcements

RELIABILITY & SAFETY:

Fail Safe Features	Vehicles have additional emergency running wheel and emergency guidewheel to enable failed vehicle to drive to station, by-pass line or maintenance station. [e 14]
Fail Operational Features	Information unavailable
Total System Mean Time Before Failure	2,000 hrs
System Restore Time After Failure	0.3 hrs
Station Mean Time Before Failure	10,000 hrs
Station Restore Time After Failure	0.3 hrs
Vehicle Mean Time Before Failure	3,000 hrs
Strategy For Removal of Failed Vehicle	Vehicles have emergency running wheel and emergency guidewheel. [e 14]
Strategy For Passenger Evacuation of Failed Vehicle	Emergency path in center of double land guideway for emergency exit on foot; above-grade guideway can include emergency trap door and pull down escape ladder. [e 14]
System Lifetime	20 years
Vehicle Lifetime	13 years

MAINTENANCE:

Inspection Frequency (One-way guideway assumed)	
Guideway	1.5 hrs every 1 days/18.6 mi (30 km)
Station	Data unavailable
Vehicle	0.2 hrs every day
Periodic Maintenance	
Guideway	Data unavailable
Station	1 hrs every 30 days
Vehicle	6 hrs every 30 days
Adjustments Required	Information unavailable
Other Maintenance	ATO, CTC - 6 hrs every 2 months

CARGO CAPABILITY:

Passenger Articles	Only small hand carried packages
Goods Movement	Passenger cab is easily replaced with a freight module

PERSONNEL REQUIREMENTS:

Typical System of 120 vehicles, 7 stations and 9.3 mi (15 km) of one-way guideway	
No. of Operators/Vehicle	None
No. of Attendants/Station	3 [f]
No. of Adminstration Personnel	19
No. of Central Control Attendants	12/24 hrs
No. of Maintenance Personnel	27
Engineering Staff	4

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length	17.39 ft (5300 mm)
Overall Width	6.76 ft (2060 mm)
Overall Height	10.04 ft (3060 mm)
Empty Weight	9,923 lbs (4500 kg)
Gross Weight	13,779 lbs (6250 kg)
Passenger Space (Design Load)	3.01 ft^2 (0.28 m^2) seated 2.69 ft^2 (0.25 m^2) standing
Doorway Width	39.37 in (1000 mm)
Doorway Height	71.14 in (1807 mm)
Step Height	Level

SUSPENSION:

Type	Supported by 4 pneumatic tires on 2 axles, bogies and leaf springs
Design Load	5,015 lbs (2275 kg)/front suspension 5,015 lbs (2275 kg)/rear suspension
Lateral Guidance	Center guide beam

PROPULSION & BRAKING:

Type & No. Motors	One rotary dc electric traction motor per vehicle, 500 vdc
Motor Placement	Aboard vehicle
Motor Rating	73.8 HP, 55 kw at 2200 rpm
Type Drive	Differential gear
Gear Ratio	5.857:1
Type Power	600 vdc, 220 max amps
Power Collection	By current collector shoes
Type Service Brakes	Hydraulic brakes
Type Emergency Brakes	Spring brakes
Emergency Brake Reaction Time	0.3 sec

SWITCHING:

Type & Emplacement	Rotating guideway horizontally
Switch Time (lock-to-lock)	10 sec
Speed Thru Switch	37 mph (60 km/h) max
Headway Thru Switch	60 sec min

GUIDEWAY:

Type	Above-grade; two running beams and one guiding wide-flange steel beam
Materials	Steel
Running Surface Width	0.98 ft (300 mm)
Single Lane Elevated Guideway:	
Max Elevated Span	Standard 49.2 ft (15000 mm)
Overall Cross Section Width	5.25 ft (1600 mm)
Overall Cross Section Height	1.94 ft (590 mm)
Design Load	1,143 lbs/ft (1700 kg/m)
Double Lane Elevated Guideway:	
Max Elevated Span	Standard 49.21 ft (15000 mm)
Overall Cross Section Width	14.11 ft (4300 mm)
Overall Cross Section Height	1.94 ft (590 mm)
Design Load	1,143 lbs/ft (1700 kg/m)
Guideway Passenger Emergency Egress	Provided in center or along side of guideway
Type Elevated Guideway Support Columns	Steel pipe or reinforced concrete

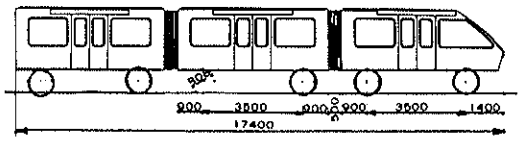
CONTROL:

Command and control is a totally automatic hierarchy. A central computer processes demands and adjusts schedules, numbers of vehicles per trains, routes, destinations, automatic train control, power system control, failure detection and maintenance, ticketing, and is used in business accounting. Headway control is asynchronous. Wayside automatic control equipment is located at stations.

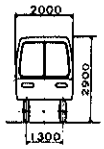
STATIONS:

Stations are either fixed platforms to accommodate max train length of 228.3 ft (69.6 m) as center islands or separate side platforms. Circular stations are also proposed whereby the train continues to move at 1.24 mph (2 km/hr) and passengers board via a rotating constant speed platform.

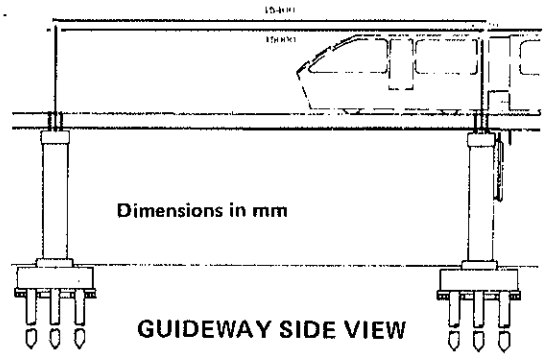
Ticket-fare collection machine, guidance, speakers, light, television camera, etc., will be installed. If necessary, elevator, escalator or moving way can be provided.



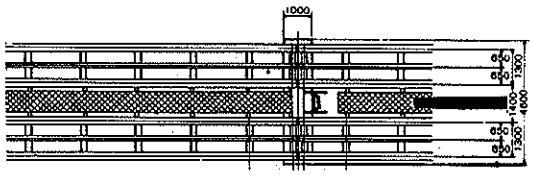
Dimensions in mm



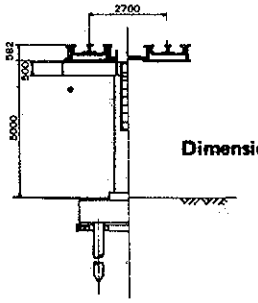
VEHICLE & TRAIN DIMENSIONS



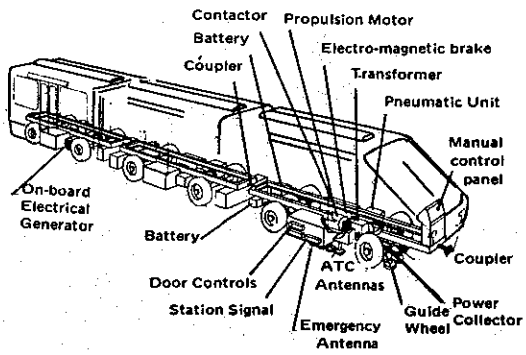
GUIDEWAY SIDE VIEW



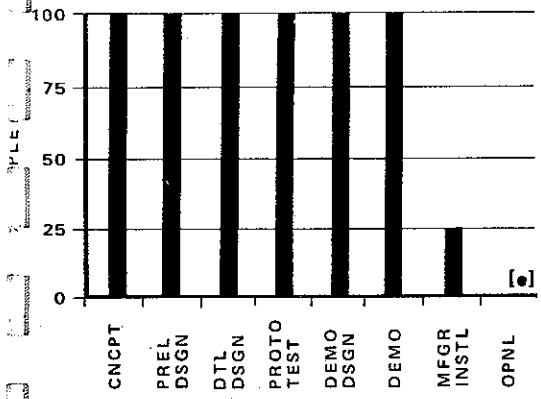
GUIDEWAY PLAN VIEW



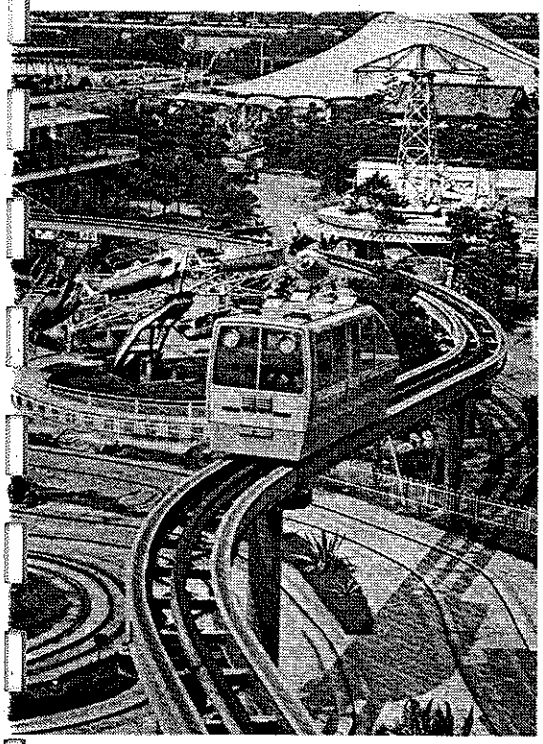
GUIDEWAY CROSS SECTION



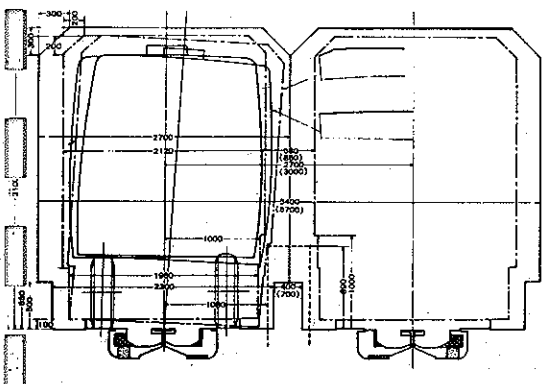
VEHICLE & TRAIN COMPONENTS



DEVELOPMENT STATUS



PROTOTYPE DEMONSTRATION AT YATSU PARK



INSTALLATION ENVELOPE

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The VONA System has been developed jointly by Mitsui & Co. Ltd. and Nippon Sharyo Seizo Kaisha Ltd. The following prototypes for testing have been constructed:

October, 1971	— 150 m test line at Toyokawa Factory in Aichi Pre.
March, 1972	— 400 m prototype line at Yatsu Park in Chiba Pre.
May, 1973	— 400 m test line at Toyokawa

INSTALLATIONS & CONTRACTS:

Prototype at Yatsu Park in Chiba Pre.
- — 400 m single way elevated guideway
- — two vehicles
- — totally automatic operation

COSTS:

(Based upon typical system of 9.3 mi (15 km) single lane guideway, 7 stations, 120 vehicles, 130 veh-mi/day, 7 veh-hr/day, 840 hrs operation per day)

Capital Cost	Total avg of $5,280,000/mi ($3,300,000/km) single lane
Avg Cost per Single Lane Guideway	$2,080,000/mi ($1,300,000/km)
Avg Cost per Station	$900,000
Avg Cost per Vehicle	$80,000
Computers, Software, & Control Center	$5,300,000
Maintenance & Storage Facilities	$5,300,000
Power Distribution & Substations	$2,700,000
Operation & Maintenance Costs	Total avg 6.4 cents/veh-mi (4 cents veh-km)

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	8.86 ft (2700 mm) [e]
Single Lane Guideway Envelope Height	12.4 ft (3782 mm) [e]
Single Lane Guideway Structural Weight	470 lbs/ft (700 kg/m)
Double Lane Guideway Structural Weight	873 lbs/ft (1300 kg/m)
Max Grade	7%
Min Vertical Turn Radius	1,640 ft (500 m) at 37 mph (60 km/h)
Min Horizontal Turn Radius	65.6 ft (20 m) at 10 mph (16 km/h)
Construction Process	Off-site prefabricated guideway sections
Staging Capability	A loop could be installed and operated while others are under construction.

LIMITATIONS:

On-line stations limit headway to 90 sec. [e]

Installations would probably be limited to new towns or other new developments.

Standing passengers limit max service accel/decel to approx 4.1 ft/sec^2 (1.25 m/sec^2).

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions

Visual, Single Lane Elevated Guideway . . . . . .

H_1 — 1.94 ft (590 mm), H_2 — 11.97 ft (3650 mm)
W_1 — 5.25 ft (1600 mm), W_2 — 6.76 ft (2060 mm)
P_1 — 5.09 ft (1550 mm), P_2 — 11.78 ft (3590 mm)

Noise . . . . . 70 dbA inside vehicle
65 dbA at 26 ft (8 m) to side of vehicle

WESTINGHOUSE TRANSIT EXPRESSWAY

CLASSIFICATION: Light Guideway Transit

OTHER NAMES: Skybus, Tampa International Airport Passenger Shuttle System

Seattle-Tacoma International Airport Satellite Transit System

Passenger Transfer System at Busch Gardens Williamsburg, Virginia

Miami International Airport Satellite Shuttle System

DEVELOPER: Westinghouse Electric Corp.
Transportation Division
2001 Lebanon Road
West Mifflin, Pennsylvania 15122
U.S.A.
Tel: (412) 256-6701

LICENSEES: None

PATENTS: Data unavailable

DATA REFERENCE CODE: [a 21/a 51: except as noted]

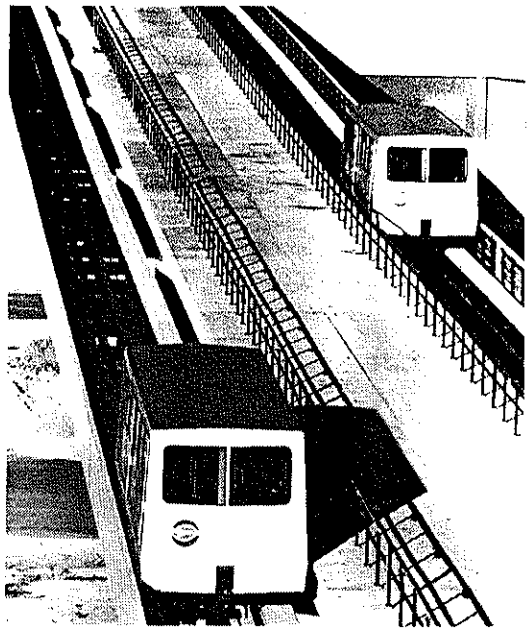
SYSTEM DESCRIPTION:

The Transit Expressway may be operated manually, however to-date all installations are totally automated systems for transporting passengers, in a limited area along a line or around loops, in rubber-tired electrically propelled vehicles, over exclusive guideways, between on-line stations. Service is scheduled, based upon anticipated passenger demand.

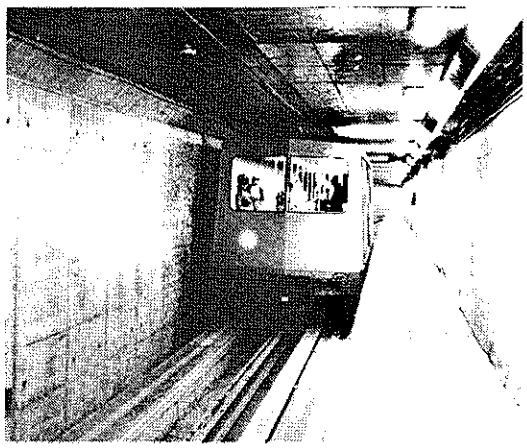
The Tampa Airport installation operates a single vehicle on its exclusive guideway as essentially a horizontal elevator. The Seattle/Tacoma Airport operates trains of vehicles on two separate loops with a separate shuttle link over which passengers may transfer between loops.

PUBLISHER'S NOTE:

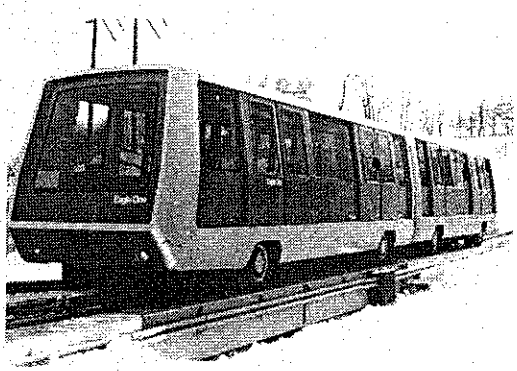
The Transit Expressway is essentially a technology with a set design for vehicle suspension propulsion, and control. The size of the vehicle and guideway configuration, as well as operating characteristics, may vary dependent upon an installation. These data sheets utilize the following annotation: Tampa installation (denoted T), Seattle/Tacoma installation (denoted S), Miami Airport installation (denoted M), and the Anheuser-Busch (Busch Garden) installation (denoted B).



TAMPA VEHICLES ON GUIDEWAY

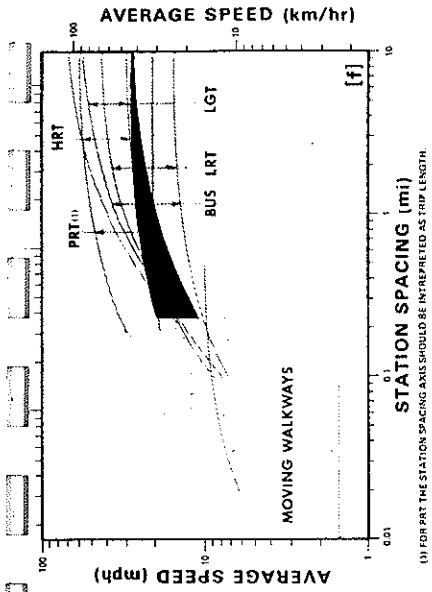


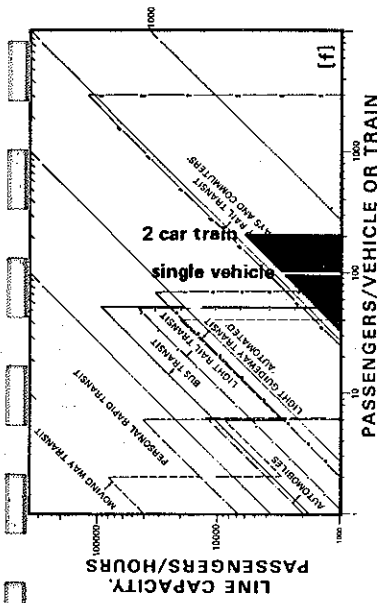
SEA-TAC VEHICLE INSIDE GUIDEWAY

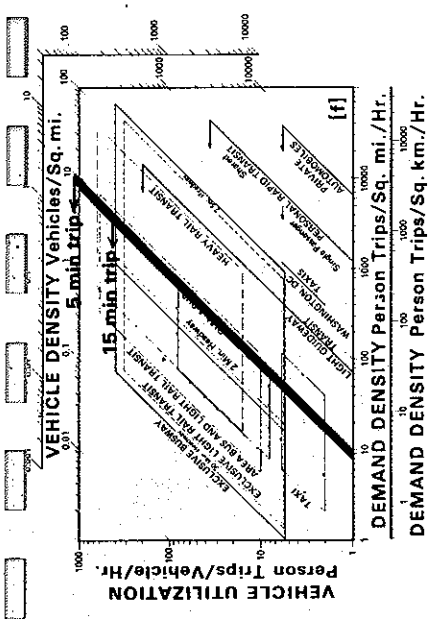


BUSCH GARDENS VEHICLE ON GUIDEWAY

SEA-TAC VEHICLE INTERIOR







OPERATIONAL CHARACTERISTICS

SYSTEM PERFORMANCE:

Max Theoretical One-Way Capacity . . . . T[1] - 5,040 psgr/hr, S[2] - 4,800 psgr/hr, M[3] - 6,000 psgr/hr, B[4] - 2,000 psgr/hr (Phase I), B - 6,000 psgr/hr (Design)

Max Practical One-Way Capacity . . . . . T - 5,040 psgr/hr, S - 4,800 psgr/hr M - 6,000 psgr/hr, M - 2,000 psgr/hr (Phase I) B - 6,000 psgr/hr (Design)

Min Theoretical Headway . . . . . .T - 70 sec, S - 105 sec, M - 85 sec, B - 5 min (Phase I), B - 100 sec (Design)

Min Practical Headway . . . . . .T - 70 sec, S - 105 sec, M - 85 sec, B - 5 min (Phase I), B - 100 sec (Design)

Availability . . . . . Scheduled and on-demand

Type Service . . . . . .Limited area, point-to-point, and/or collection/distribution

Type Network . . . .T - star pattern of legs, S - 2 loop with separate shuttle link, M - 1 shuttle leg, B - 1 loop

Type of Vehicle Routing . . . . . Fixed

Traveling Unit . . . . . .T - single vehicles, S - 7 trains of 1-2 veh each, M - 2 trains of 2 veh each, B - 1 train of 2 veh each (Phase I), B - 3 trains of 2 veh each (Design)

VEHICLE PERFORMANCE:

Cruise Velocity . . . . . T - Not applicable, S - 26 mph (42 km/h), M - not applicable, B - 30 mph (48 km/h)

Max Velocity . . . . . .T - 30 mph (48 km/h), S - 30 mph (48 km/h), M - 28 mph (45 km/h), B - 30 mph (48 km/h)

Max Grade . . . . . T - 1%, S - 4%, M - 2%, B - 10%

Service Acceleration . . . . T - 2.93 ft/s^2 (0.89 m/s^2), S - 2.93 ft/s^2 (0.89 m/s^2), M - 2.93 ft/s^2 (0.89 m/s^2), B - 2.93 ft/s^2 (0.89 m/s^2)

Service Deceleration . . . . . T - 2.2 ft/s^2 (0.67 m/s^2), S - 2.2 ft/s^2 (0.67 m/s^2), M - 2.2 ft/s^2 (0.67 m/s^2), B - 2.2 ft/s^2 (0.67 m/s^2)

Max Jerk . . . . . T - 2.2 ft/s^3 (0.67 m/s^3), S - 2.2 ft/s^3 (0.67 m/s^3), M - 2.2 ft/s^3 (0.67 m/s^3), B - 2.2 ft/s^3 (0.67 m/s^3)

Emergency Decel . . . . . .T - 7.3 ft/s^2 (2.2 m/s^2), S - 7.3 ft/s^2 (2.2 m/s^2), M - 7.3 ft/s^2 (2.2 m/s^2), B - 7.3 ft/s^2 (2.2 m/s^2)

Stopping Precision in Station . . . . . .T - ±12 in (305 mm), S - ±12 in (305 mm), M - ±12 in (305 mm), B - ±12 in (305 mm)

Degradation if Guideway is Wet . . . . . Data unavailable

Degradation for Ice and Snow . . . . . Data unavailable

Vehicle Design Capacity . .T - 0 seated, 100 standing, S - 12 seated, 90 standing, M - 0 seated, 100 standing, B - 8 seated, 92 standing

Vehicle Crush Capacity . . . . . Data unavailable

Energy Consumption . . . . . Dependent on system design characteristics

STATIONS:

Type . . . . . On-line

Type Boarding . . . . . Level

Ticket or Fare Collection . . . . . .Free service

Security . . . . . .Not required - located in airport

Boarding Capacity . . . . . .T - 5,040 psgr/hr/leg, S - 4,800 psgr/hr/leg, M - 6,000 psgr/hr/leg, B - 2,000 psgr/hr/leg

Deboarding Capacity . . . . . .T - 5,040 psgr/hr/leg, S - 4,800 psgr/hr/leg, M - 6,000 psgr/hr/leg, B - 2,000 psgr/hr/leg

Max Wait Time . . . . . T - 45 sec, S - 100 sec, M - 85 sec, B - 5 min

Vehicle in Station Dwell Time . . . . . T - 30 sec, S - 45-50 sec, M - 20 sec, B - 20 sec

Average Station Spacing . . . . . .T - 780 or 1,000 ft (238 or 305 m), S - 1,300 ft (396 m), M - 1,320 ft (402 m), B - 3,500 ft (1067 m)

INDIVIDUAL SERVICE:

Privacy . . . . . Passengers share vehicle.

Transfers . . . . . Yes, if trip requires

Stops . . . . . T - non-stop per leg, S - stops at each station, M - non-stop per track, B - stops at each station

Accommodation . . . . . T - standing only, S - seated and standing, M - standing only, B - seated and standing

Comfort . . . . . .Climate control aboard vehicle

Security . . . . . .S - closed circuit TV

Instruction . . . . . .T, S, M - signs and audible announcements

RELIABILITY & SAFETY:

Fail Safe Features . . . . . All critical subsystems are fail-safe. M, T equipped with overshoot protection.

Fail Operational Features . . . . . .Stops safely at service deceleration. [e]

System Lifetime . . . . . 20 years

Vehicle Lifetime . . . . . Data unavailable

[1] T - Tampa Airport Installation

[2] S - Seattle/Tacoma Airport Installation

[3] M - Miami Airport Installation

[4] B - Busch Garden Installation

MAINTENANCE:

T . . . . . .Maintenance area at main terminal end of each leg, plus a general maintenance area for all legs
S . . . . . .Two maintenance and storage facilities, plus two transfer tables and four filler tables for adding or subtracting vehicles
M and B . . . . . Data unavailable

CARGO CAPABILITY:

Passenger Articles . . . . . .Luggage, small packages, and wheelchairs
Goods Movement . . . . . .Not provided

PERSONNEL REQUIREMENTS:

Data unavailable

PHYSICAL DESCRIPTION

VEHICLE:

Overall Length . . . . . .T - 36.25 ft (11.05 m), S - 37.00 ft (11.28 m), M, B - 36.33 ft (11.07 m)
Overall Width . . . . . T, S - 9.33 ft (2.84 m), M, B - 9.75 ft (2.84 m)
Overall Height . . . . . 11.00 ft (3.35 m)
Empty Weight . . . . . .T - 21,500 lbs (9772 kg), S - 25,500 lbs (11591 kg) M, B - 26,500 lbs (12020 kg)
Gross Weight . . . . . .T - 40,240 lbs (18290 kg), S - 46,700 lbs (21227 kg) M, B - 44,677 lbs (20264 kg)
Passenger Space (Design Load) . . . . . 2.5 ft^2 (0.23 m^2) (standing)
Doorway Width . . . . . .T, S - 8.0 ft (2.44 m), M, B - 7.0 ft (2.13 m)
Doorway Height . . . . . T, S - 6.67 ft (2.03 m), M, B - 6.67 ft (2.03 m)
Step Height . . . . . Data unavailable

SUSPENSION:

Type . . . . . .Supported on pneumatic drive tires in two dual sets on each of two automotive axles (2 bogies)
Design Load . . . . . 25,000 lbs on each bogie to accommodate crush passenger load
Lateral Guidance . . . . . 18 in (457 mm)

PROPULSION & BRAKING:

Type & No. Motors . . . . . Series wound dc traction motors, T - 2 each/veh, S - 1 each/veh
Motor Placement . . . . . .Aboard vehicle
Motor Rating . . . . . 100 each HP, 39 kw
Type Drive . . . . . Data unavailable
Gear Ratio . . . . . Data unavailable
Type Power . . . . . 480 vac 3ϕ - full wave thryristor converter
Power Collection . . . . . 3 power rails on guideway - collecter shoes on vehicle
Type Service Brakes . . . . . Truck type air-operated drum brakes
Type Emergency Brakes . . . . . Fail-safe spring loaded drum brakes
Emergency Brake Reaction Time . . . . . Data unavailable

SWITCHING:

Type & Emplacement . . . . . Sea-Tac and Busch systems use transfer tables for adding or subtracting vehicles only.
The Transit Expressway switch includes an electric cylinder drive motor, two sections of guideway and the tangent and curved guidebeams.
Switch Time (lock-to-lock) . . . . . Transit Expressway - 7 sec
Speed Thru Switch . . . . . Transit Expressway - no additional speed restriction
Headway Thru Switch . . . . . Data unavailable

GUIDEWAY:

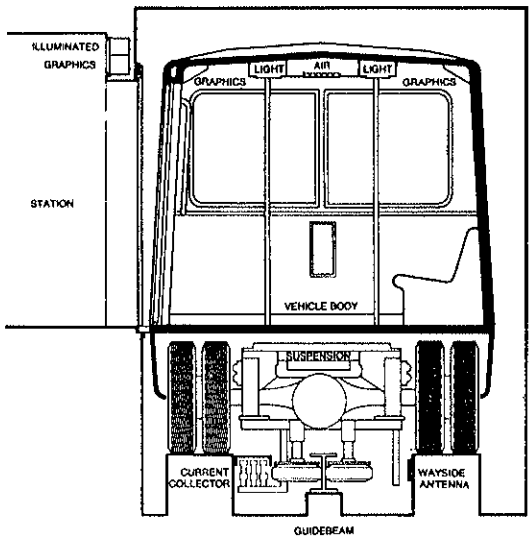
Type . . . . . Two flat riding surfaces with center guidebeam
Materials . . . . . .T - steel/concrete, S - concrete
Running Surface Width . . . . . 8.5 ft (2.59 m) one-way
Single Lane Elevated Guideway:
Max Elevated Span . . . . . Data unavailable
Overall Cross Section Width . . . . . 2.91 ft (887 mm)
Overall Cross Section Height . . . . . 8.50 ft (2590 mm)
Design Load . . . . . Data unavailable
Guideway Passenger Emergency Egress . . . . Tampa and Sea-Tac Systems appear to be provided with walkways along the guideway. [e]

CONTROL:

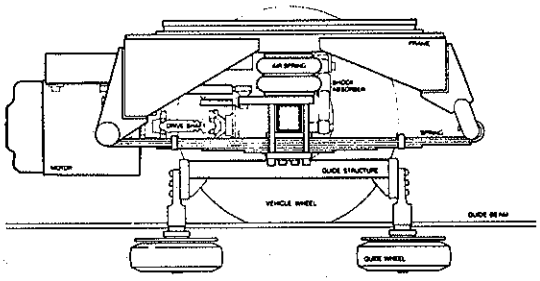
The vehicle borne control system (automatic train control) is essentially the same for Tampa, Sea-Tac, Miami and Busch systems taking commands of "stop", "go", "open/close doors", and velocity from a wayside controller via wayside inductive loop communication. However, Busch utilizes sliding contact on an ATC rail. In addition, the Miami and the Tampa vehicles contain a track end overshoot protection system independent of the programmed stop system. In addition, the Sea-Tac and Busch systems incorporated a fixed-block headway control which is part of its automatic train protection system and an automatic line supervision system which monitors and regulates traffic in the total system.

STATIONS:

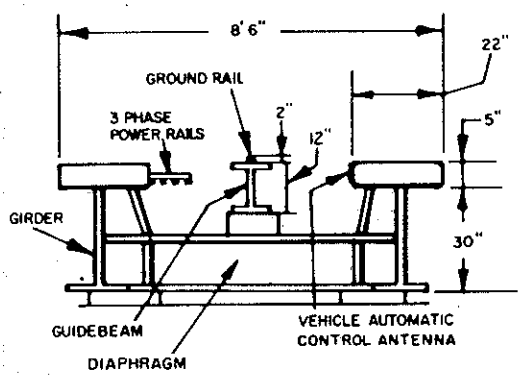
Tampa: Bays at the end of each leg with doors similar to those of elevators, one side for boarding and the other for disembarking, and a call button
Sea-Tac: Doors same as Tampa except used for both boarding and disembarking; within the main airport terminal, one side is for vehicles traveling on a loop (North or South) and the other for the shuttle which connects both loops.
Miami: Doors same as Tampa except used for both boarding and disembarking
Busch: Does not use lobby doors; people enter the train on one side and exit on the other.



SEA-TAC VEHICLE, GUIDEWAY, & STATION CROSS SECTION (others similar)

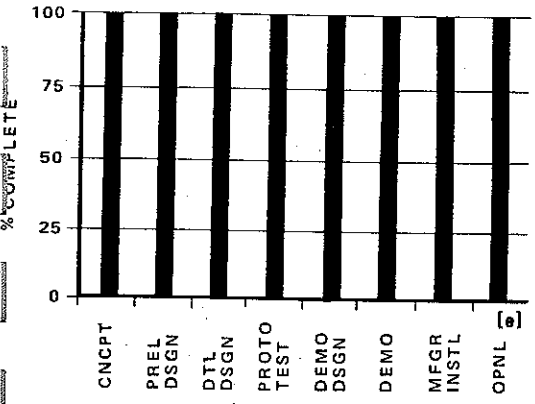


STEERING AND SUSPENSION SYSTEM SIDE VIEW

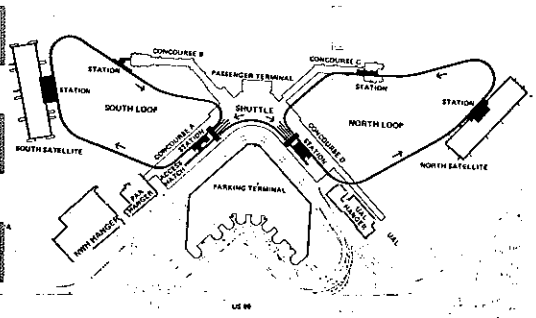


TAMPA STEEL GUIDEWAY CROSS SECTION
(Same dimensions for Sea-Tac)

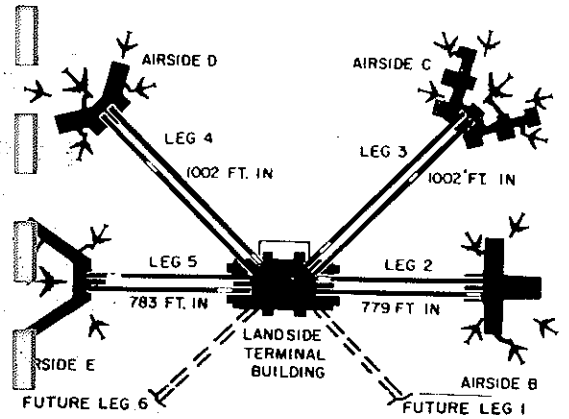
TRANSIT EXPRESSWAY SWITCH



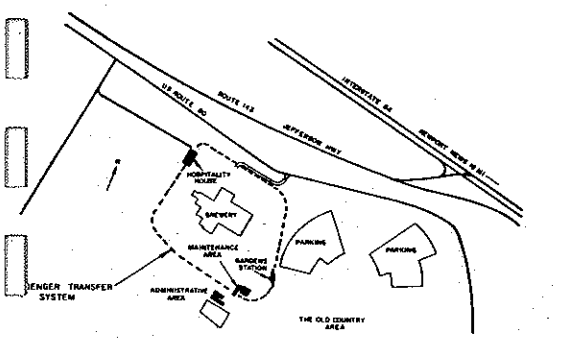
DEVELOPMENT STATUS



SEA-TAC SYSTEM



TAMPA SYSTEM
(Miami system similar except only one leg)



BUSCH GARDENS SYSTEM

DEVELOPMENT HISTORY, PLANS & PROGRESS:

The basic vehicle and guideway technology was developed by Westinghouse for the Pittsburgh Transit Expressway which was demonstrated in 1966 at South Park for a cost of $7.4 million. The Tampa system had its beginning in 1965 when the Hillsborough County Aviation Authority contracted Westinghouse to develop that system which was placed in service in April, 1971. The Port of Seattle contracted Westinghouse for the Sea-Tac system and construction began in 1969. Service operations began in 1972.

INSTALLATIONS & CONTRACTS:

Tampa: 7,132 ft (2,174 m) of single lane guideway, 8 vehicles, 8 vehicle control systems 8 power distribution systems, 64 platform doors, 8 communication systems, and 5 maintenance facilities — planned expansion for 2 more legs, system cost of $5.5 million total

Sea-Tac: 9,050 ft (2,758 m) of single lane guideway, 9 vehicles, 1 service vehicle, 9 south loop control blocks, 11 north loop control blocks, 8 programmed stop locations, 30 sets of station doors, 1 central control, 2 transfer tables, 4 filler tables, 2 maintenance facilities, system cost of $5.3 million total

Miami Airport: Contracted in 1973 for a 1300 ft shuttle system to link main terminal with new satellite international complex; operation is to begin the end of 1975. Additional info: 4 vehicles (2-two car trains) 32 lobby doors, automatic transit control, power distribution, communications system, maintenance facility

Busch Gardens: A 1.3 mi (2.1 km) system to transport visitors between the gardens and entertainment complex, to open in 1975; 1 two car train, 7,000 ft loop (2,800 ft aerial, 4,200 ft at-grade) automatic transit control, communication system, power distribution system, transfer table system (system can be expanded to two additional trains)

COSTS:

Data unavailable for publication

INSTALLATION OR RETROFIT CAPABILITY:

Single Lane Guideway Envelope Width	10.5 ft (3.2 m)
Single Lane Guideway Envelope Height	15 ft (4.56 m)
Single Lane Guideway Structural Weight	Data unavailable
Double Lane Guideway Structural Weight	Data unavailable
Max Grade	6% sustained, 10% max
Min Vertical Turn Radius	Data unavailable
Min Horizontal Turn Radius	90 - 190 ft (25 - 58 m)
Construction Process	Poured in place guideway road surface and prefabricated guidebeams
Staging Capability	Sections or loops can be operated while others are under construction.

LIMITATIONS: [e]

Tampa: Capacity is limited to max design value
Should a vehicle become inoperable, then the traffic on that leg has to be carried by the other vehicle on the parallel guideway.
Essentially same limitations as an elevator

Sea-Tac: Fixed-block control system fixes headway
Passengers must make 2 transfers between north and south loops (cannot travel direct).

ENVIRONMENTAL IMPACT:

Emissions . . . . . No direct polluting emissions [e]

Visual, Single Lane Elevated Guideway . . . . .
H_1 – 2.91 ft (887 mm), H_2 – 13.91 ft (4240 mm)
W_1 – 8.50 ft (2590 mm), W_2 – 9.33 ft (2840 mm)
P_1 – 8.10 ft (2470 mm), P_2 – 16.10 ft (4910 mm)

Noise . . . . . NCA 70 inside vehicle
NCA 70 directly beneath guideway
NCA 60 at 100 ft (30.5 m) to side
NCA level unavailable above guideway